RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 7 of 15

Upper Walnut Drainage
Exposure Unit

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ACRONYMS AND ABBREVIATIONS

μg/kg	microgram per kilogram
μg/L	microgram per liter
AEU	Aquatic Exposure Unit
AI	adequate intake
BAF	bioaccumulation factor
bgs	below ground surface
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CD	compact disc
CDPHE	Colorado Department of Public Health and Environment
CMS	Corrective Measures Study
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CSF	cancer slope factor
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRI	dietary reference intake
ECOC	ecological contaminant of concern
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
Eco-SSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency

EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
FWS	U.S. Fish and Wildlife Service
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HRR	Historical Release Report
IA	Industrial Area
IAEU	Industrial Area Exposure Unit
IAG	Interagency Agreement
IDEU	Inter-Drainage Exposure Unit
IHSS	Individual Hazardous Substance Site
kg	kilogram
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effects concentration
LWNEU	Lower Walnut Drainage Exposure Unit
MDC	maximum detected concentration
mg	milligram
mg/day	milligram per day
mg/kg	milligram per kilogram
mg/kg BW/day	milligram per kilogram receptor body weight per day
mg/l	milligram per liter
mL	milliliter
mL/day	milliliter per day

msl	mean seal level
N/A	not applicable or not available
NFA	No Further Action
NFAA	No Further Accelerated Action
NNEU	No Name Gulch Drainage Exposure Unit
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
QAPjP	Quality Assurance Project Plan
RCEU	Rock Creek Drainage Exposure Unit
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDI	recommended daily intake
RFCA	Rocky Flats Cleanup Agreement
RfD	reference dose

RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	site conceptual model
SEP	Solar Evaporation Ponds
tESL	threshold ESL
TRV	toxicity reference value
UBC	Under Building Contamination
UCL	upper confidence limit
UL	upper limit daily intake
UT	uncertain toxicity
UTL	upper tolerance limit
UWNEU	Upper Walnut Drainage Exposure Unit
VOC	volatile organic compound
WBEU	Wind Blown Area Exposure Unit
WRS	Wilcoxon Rank Sum
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

EXECUTIVE SUMMARY

This report presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 403-acre Upper Walnut Drainage Exposure Unit (EU) (UWNEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess risks to human health and ecological receptors posed by exposure to contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs) remaining at the UWNEU after completion of accelerated actions at RFETS.

Results of the risk characterization for the HHRA indicate that excess lifetime cancer risks for the wildlife refuge worker (WRW) and the wildlife refuge visitor (WRV) in the UWNEU are within or below U.S. Environmental Protection Agency (EPA)-acceptable risk range (i.e., within or below 1E-04 to 1E-06). Benzo(a)pyrene was selected as the only COC for surface soil/surface sediment. No COCs were selected for subsurface soil.

The estimated total excess lifetime cancer risk to the WRW at the UWNEU is 1E-06 based on the Tier 1 EPC and 1E-06 based on the Tier 2 EPC. The estimated total excess lifetime cancer risk to the WRV at the UWNEU is 2E-06 based on the Tier 1 EPC and 1E-06 based on the Tier 2 EPC. Noncancer risk for benzo(a)pyrene was not estimated because benzo(a)pyrene does not have a noncancer toxicity value. Although benzo(a)pyrene was selected as a COC and was evaluated quantitatively in the HHRA, it has not necessarily been directly associated with historical Individual Hazardous Substance Sites (IHSSs) in the UWNEU, but could be associated with traffic, pavement degradation, or pavement operations in the UWNEU and the nearby Industrial Area Exposure Unit (IAEU).

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the UWNEU. The ECOPC identification process is described in the Comprehensive Risk Assessment (CRA) Methodology (U.S. Department of Energy [DOE] 2005a) and additional details are provided in Appendix A, Volume 2 of the Remedial Investigation/Feasibility Study (RI/FS) Report. Antimony, copper, molybdenum, nickel, silver, tin, vanadium, zinc, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total polychlorinated biphenyls (PCBs) were identified as ECOPCs for representative populations of non-Preble's meadow jumping mouse (PMJM) receptors in surface soil. ECOPCs for individual PMJM receptors included antimony, nickel, tin, vanadium, and zinc. No ECOPCs were identified in subsurface soil for burrowing receptors.

ECOPC/receptor pairs were evaluated in the risk characterization using conservative default exposure and risk assumptions as defined in the CRA Methodology. Tier 1 and Tier 2 EPCs were used in the risk characterization: Tier 1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. In addition, a refinement of the exposure and risk models based on chemical-specific uncertainties associated with the initial default exposure models were completed for several ECOPC/receptor pairs to provide a refined estimate of potential risk.

Using Tier 1 EPCs and default exposure and risk assumptions, No observed adverse effect level (NOAEL) or in some cases lowest observed effect concentration (LOEC) hazard quotients (HQs) ranged from 47 (nickel/deer mouse-insectivore) to less than 1 (several ECOPC/receptor pairs). NOAEL or LOEC HQs also ranged from 129 (vanadium/terrestrial plants) to less than 1 (several ECOPC/receptor pairs) using Tier 2 EPCs and default exposure and risk assumptions.

For terrestrial plants, antimony, silver, vanadium, and zinc all had HQs greater than or equal to 1 using Tier 1 and Tier 2 EPCs. However, there is low confidence placed in the ecological screening levels (ESLs) for terrestrial plants for all four of these ECOPCs. As discussed in Attachment 5, additional NOEC or LOEC values for antimony, silver and zinc were either not acceptable for use in the CRA (low confidence in the additional values) or not available in the literature. For vanadium, an additional LOEC value was available for refined risk calculations.

For antimony, the LOEC HQ was greater than 1 for both the Tier 1 and Tier 2 UTL (HQs = 6 and 4 respectively). For silver, the LOEC HQ was equal to 1 using the Tier 1 UTL, but greater than 1 using the Tier 2 UTL (HQ = 4). For zinc, HQs were greater than 1 using both the Tier 1 and Tier 2 UTLs (HQs = 2). Therefore, risks to populations of terrestrial plants from exposure to antimony, silver, and zinc in surface soils are likely to be low to moderate but with a high level of uncertainty due to low confidence in the ESLs.

For vanadium, HQs based on the default ESL (2 mg/kg) were greater than 1 using both the Tier 1 and Tier 2 UTLs. The uncertainty assessment recommended using an additional LOEC value (50 mg/kg) in a refined risk calculation. HQs were less than 1 using the Tier 1 EPC and greater than 1 using the Tier 2 EPC in the refined analysis. The potential for risk to terrestrial plant populations in the UWNEU from exposure to vanadium in surface soils is likely to be low to moderate although there is high uncertainty or low confidence in both ESLs used in the risk calculations. In addition, the HQ based on the default ESL and the background UTL (HQ = 23) is similar to the HQ based on the default ESL and the UWOEU Tier 1 UTL (HQ = 25).

Most of the ECOPC/receptor pairs for birds and mammals had lowest observed adverse effect level (LOAEL) HQs less than or equal to 1 using the default assumptions used in the risk calculations. However, the following ECOPC/receptor pairs had LOAEL HQs greater than 1 using the default exposure and toxicity assumptions:

- Antimony/deer mouse (insectivore) - – The LOAEL HQ was equal to 3 and 2 using the Tier 1 and Tier 2 EPCs in the default risk model, respectively. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. The potential for risks to populations of small mammals such as the deer mouse (insectivore) are likely to be low to moderate. However, there is considerable uncertainty or low confidence in the default risk model.

- Antimony/PMJM – The LOAEL HQ was equal to 2 in Patch #18 using the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that the LOAEL HQ is only equal to 2, risks to PMJM receptors within Patch #18 are likely to be low but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWNEU are likely low. However, there is considerable uncertainty or low confidence in the default risk model.

- Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 5 and 4 using the Tier 1 and Tier 2 EPCs, respectively. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, no LOAEL HQs greater than 1 were calculated. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). No HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV in the refined analysis. Based on these additional risk calculations using the median BAF or the additional NOAEL or LOAEL TRVs, risks to populations of small mammals such as the deer mouse (insectivore) receptor are likely to be low.

- Nickel/PMJM - LOAEL HQs were greater than 1 (HQs = 2) in Patches #12, #15, #17 and #18 using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, LOAEL HQs were less than 1 in all four patches. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the calculations in all four patches. Based on the additional risk calculations using either the median BAF or the additional TRVs in the refined analysis, risks to the PMJM receptor from exposure to nickel are likely to be low.

- Di-n-butylphthalate/mourning dove (insectivore) – LOAEL HQs were equal to 2 using the Tier 1 EPC and equal to 3 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small birds such as the mourning dove (insectivore) receptor are likely to be low to moderate although there is considerable uncertainty or low confidence in the default risk model. In addition, there is no known source of di-n-butylphthalate at UWNEU.

Based on default and refined calculations, site-related risks are likely to be low to moderate with some high levels of uncertainty for the ecological receptors evaluated in the UWNEU. In addition, data collected on wildlife abundance and diversity indicate that wildlife species richness remains high at RFETS. There are no significant risks to ecological receptors or high levels of uncertainty with the data, and therefore, there are no ecological contaminants of concern (ECOCs) for the UWNEU.

1.0 UPPER WALNUT DRAINAGE EXPOSURE UNIT

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Upper Walnut Drainage Exposure Unit (EU) (UWNEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The HHRA and ERA methods and selection of receptors are described in detail in the Final CRA Work Plan and Methodology (DOE 2005a), hereafter referred to as the CRA Methodology. A summary of the risk assessment methods, including updates made in consultation with the regulatory agencies, are summarized in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report). The anticipated future land use of RFETS is a wildlife refuge. Consequently, two human receptors, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV), are evaluated in this risk assessment consistent with this land use. A variety of representative terrestrial and aquatic receptors are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at the RFETS.

1.1 Upper Walnut Drainage Exposure Unit Description

This section provides a brief description of the UWNEU, including its location at RFETS, historical activities in the area, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0, Physical Characteristics of the Study Area, of the RI/FS Report. This information is also summarized in Appendix A of Volume 2 of the RI/FS Report.

The Historical Release Report (HRR) and its annual updates provide descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR (DOE 1992a) organized these known or suspected historical sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter collectively referred to as historical IHSSs). Individual historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) and the 1996 Rocky Flats Cleanup Agreement (RFCA), the U.S. Department of Energy (DOE) has thoroughly investigated and characterized contamination associated with these historical IHSSs. Historical IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD).

A more detailed description of the regulatory agreements and the investigation and cleanup history under these agreements is contained in Section 1.0 of the RI/FS Report. Section 1.4.3 of the RI/FS Report describes the accelerated action process, while Table 1.4 of the RI/FS Report summarizes the disposition of all historic IHSSs at RFETs. The 2005 Annual Update to the HRR (DOE 2005b) provides a description of the potential contaminant releases for each IHSS and any interim response to the releases; identification of potential contaminants based on process knowledge and site data; data collection activities; accelerated action activities (if any); and the basis for recommending NFAA.

Several historical IHSSs exist within the UWNEU (Table 1.1 and Figure 1.2) and all have received regulatory agency-approved NFAAs. This is documented in the Annual Updates to the HRR as noted in Table 1.1. Only four of these historical IHSSs required accelerated action: the Solar Evaporation Ponds (IHSS 101), which were closed in 2003; and Ponds B-1, B-2, and B-3 (IHSSs 142.5, 142.6, and 142.7), where sediments were removed in 2005. In general, accelerated actions were designed to address human health exposures. The intent of the ecological component of the CRA is to evaluate any potential risk to ecological receptors associated with the residual contamination at the site following the accelerated actions.

1.1.1 Exposure Unit Characteristics and Location

The 403-acre UWNEU is located in the north-central portion of RFETS (Figure 1.1) and contains several distinguishing features:

- The UWNEU is located within the Buffer Zone (BZ) OU and is adjacent to the Industrial Area (IA), which was used historically for manufacturing and processing operations at RFETS.

- The UWNEU encompasses portions of both the North Walnut and South Walnut drainages.

- The UWNEU is hydrologically downgradient from the IA and has received runoff and wastewater discharges associated with RFETS operations, including treated sanitary wastewater and contaminated laundry wastewater. In some cases, spills that occurred in the IA may have impacted portions of the UWNEU. Winds, although variable, are predominantly from the northwest. Therefore, the UWNEU is not in a predominantly downwind direction.

The UWNEU is bounded by the Wind Blown Area EU (WBEU) to the southeast, the Industrial Area EU (IAEU) in the southwest, the Inter-Drainage EU (IDEU) to the west, the No Name Gulch Drainage EU (NNEU) to the northwest, and the Lower Walnut Drainage EU (LWNEU) to the northeast and east. The UWNEU receives runoff from the northern portion of the IA.

1.1.2 Topography and Surface Water Hydrology

The UWNEU is the eroded edge of an alluvial terrace that naturally drains surface water to the northeast (Figure 1.2). The main topographic features of the UWNEU are the North and South Walnut Creek drainage valleys, which extend east and north from the gently sloping alluvial terraces that include the IA. The confluence of North and South Walnut Creeks occurs near the eastern boundary of the UWNEU, directly upstream from the western boundary of the LWNEU. The No Name Gulch confluence with Walnut Creek is at approximately the same location. Elevations range from 6,040 feet mean sea level (msl) at the western boundary to 5,705 feet msl at the confluence of North and South Walnut Creeks and No Name Gulch.

The principal surface water features that are visible on the aerial photograph are the A- and B-series ponds (Figure 1.3). The B-series ponds (B-1, B-2, B-3, B-4, and B-5) begin directly east of the IA and extend down South Walnut Creek to the northeast. The A-series ponds (A-1, A-2, A-3, and A-4) are located along North Walnut Creek approximately 1,500 feet north of the B-series ponds. The general purpose of these ponds was to effectively enhance water quality via detention and setting of suspended solids in surface water.

The A-series ponds are located in the North Walnut Creek drainage, downstream of the 900 Area, and include Pond A-1 (IHSS 142.1), Pond A-2 (IHSS 142.2), Pond A-3 (IHSS 142.3), Pond A-4 (IHSS 142.4), and Pond A-5 (IHSS 142.12). Pond A-1 through A-4 are located in the UWNEU whereas Pond A-5 is located in the LWNEU. In the A-series ponds, Ponds A-1 and A-2 were considered non-discharge ponds and were seldom released. During periods of heavy rain, or if water was needed downstream, there was an occasional movement of water. North Walnut Creek was routed around the upper A-series ponds so flow went into Pond A-3 and then into Pond A-4. Pond A-4 is the largest of the surface water ponds on Rocky Flats, and is discharged on a regular basis. There is no change to this configuration in the current operation of the ponds.

In the B-series ponds, Ponds B-1 and B-2 were the non-discharge ponds and were seldom released. Flow in South Walnut Creek was diverted around the first three ponds directly to Pond B-4, which flowed through to Pond B-5, the terminal pond in the B-series. Pond B-3 formerly received the discharge from the Rocky Flats wastewater treatment plant and was allowed to discharge into Pond B-4. For a number of years, water from Pond B-5 was pumped to Pond A-4, where all the water was sampled and held until the results demonstrated compliance with applicable stream standards. In 1998, direct discharge of Pond B-5 was allowed under an agreement reached with the neighboring cities and other stakeholders. Currently, Ponds B-1, B-2, and B-3 are not configured to receive water or to discharge. These ponds have been reshaped into wetlands after the accelerated action sediment removal activities that concluded in 2005. Pond B-4 is still connected to the bypass, and South Walnut Creek flows continue to go through Ponds B-4 and B-5.

1.1.3 Flora and Fauna

Vegetation in the UWNEU is predominantly grassland consisting chiefly of mesic mixed grasslands and reclaimed grasslands (Figure 1.4). The mesic mixed grassland is comprised of western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), side-oats grama (*Bouteloua curtipendula*), prairie junegrass (*Koeleria pyramidata*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), green needlegrass (*Stipa virigula*), and little bluestem (*Andropogon scoparius*). The reclaimed grasslands are a result of reclaiming disturbed areas created by historical pond and water diversion construction, and are dominated by two introduced grass species, smooth brome (*Bromus inermis*), and intermediate wheatgrass (*Agropyron intermedium*). Mesic mixed grasslands are found on hillsides surrounding the A- and B-series ponds. Wetland vegetation including wet meadow ecotones, short marshlands, and cattail marshlands covers a large extent of the UWNEU in comparison to other EUs, and is associated with pond inlets and groundwater seeps. Ponds B-1, B-2, and B-3 have been reshared into wetlands after the accelerated action activities included in 2005. Riparian shrublands and woodlands are found along North and South Walnut Creeks, and within small hillside seeps and springs.

Grasslands are important to wildlife, and grassland conditions within the UWNEU are generally good, although weeds and introduced grass species have degraded grasslands in some areas (PTI 1997). Weed control, erosion control, and reclamation activities ongoing within the EU will continue to promote native grasslands at RFETS (Nelson 2005).

No federally listed plant species are known to occur at RFETS. However, the xeric tallgrass prairie, tall upland shrubland, riparian shrubland, and plains cottonwood riparian woodland communities are considered rare and sensitive plant communities by the Colorado Natural Heritage Program (CNHP). RFETS also supports populations of four rare plant species that are listed as rare or imperiled by the CNHP. These include: forktip three-awn (*Aristida basiramea*), mountain-loving sedge (*Carex oreocharis*), carrionflower greenbriar (*Smilax herbacea var. lasioneuron*), and dwarf wild indigo (*Amorpha nana*).

Numerous animal species have been observed at RFETS and the more common ones are expected to be present in the UWNEU. Common large and medium-sized mammals likely to live at or frequent the UWNEU include the mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and desert cottontail (*Sylvilagus audubonii*). The most common reptile observed at RFETS is the western prairie rattlesnake (*Crotalis viridus)*. Common bird species include the meadowlark (*Sturnella neglecta*), vesper sparrow (*Pooecetes gramineus*), and red-winged blackbird (*Agelaius phoeniceus*). Several species of waterfowl frequent the ponds with the mallard (*Anas platyrhynchos*) being most abundant. The most common small mammal species include deer mice (*Peromyscus maniculatus*), meadow voles (*Microtus pennsylvanicus*), and prairie voles (*Microtus orchrogaster*).

RFETS supports two wildlife species listed as threatened or endangered species under the Endangered Species Act (U.S. Fish and Wildlife Service [FWS] 2005). The PMJM

(*Zapus hudsonius preblei*) and the bald eagle (*Haliaeetus leucocephalus*) are listed as threatened species. The PMJM is a federally listed threatened species found at RFETS. The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands with an adjacent thin band of upland grasslands. The bald eagle occasionally forages at RFETS although no nests have been identified on site.

There are also a number of wildlife species that have been observed at RFETS that are species of concern by the State of Colorado (FWS 2005). The plains sharp-tailed grouse (*Tympanuchus phasianellus jamesii*) is listed as endangered by the State and has been observed infrequently at RFETS. The western burrowing owl (*Athene cunicularia hypugea*) is listed as threatened by the State and is a known resident or regular visitor at RFETS. The ferruginous hawk (*Buteo regalis*), American peregrine falcon (*Falco peregrinus*), and the northern leopard frog (*Rana pipiens*) are listed as species of special concern by the State and are considered known residents or regular visitors at RFETS. The following species are listed as species of special concern and are observed infrequently at RFETS: greater sandhill crane (*Grus canadensis tibida*), long-billed curlew (*Numenius americanus*), mountain plover (*Charadrius montanus*), and the common garter snake (*Thamnophis sirtalis*).

More information on the plant communities and animal species that exist within RFETS is provided in Section 2.0 of the RI/FS Report.

1.1.4 Preble's Meadow Jumping Mouse Habitat Within Upper Walnut Exposure Unit

The UWNEU supports habitat for the federally protected PMJM (Figure 1.5). PMJM habitat within the EU occurs along Walnut Creek above and among the upper A-series ponds and among the lower B-series ponds. PMJM have been captured within UWNEU over a 5-year period (DOE 1995; K-H 2000). Two separate populations exist in Upper Walnut Creek, one population in the upper A-series ponds and one in the lower B-series ponds. The upper A-series pond area supports approximately 20 (±1) individuals per kilometer of stream (K-H 2000), while the lower B-series pond area supports approximately six (±1) individuals per kilometer of stream (K-H 2000). This equates to approximately 26 individuals in the UWNEU. Relative densities of PMJM in the B-series ponds have been higher (DOE 1995) than those reported in 1999 (K-H 2000). In addition, species of concern were the subject of special studies under the monitoring program. Prior to and during the period that the PMJM has been federally protected, RFETS ecologists conducted trapping surveys, radio telemetry studies, and estimated populations in all the major drainages in RFETS including those in the UWNEU (Ebasco 1992; ECMP 1995; K-H 1996; K-H 1998; K-H 1999; and K-H 2000).

Sitewide PMJM habitat patches were developed in an effort to characterize habitat discontinuity and provide indications of varying habitat quality. PMJM patches within the UWNEU are presented in Figure 1.5. PMJM patches aid in the evaluation of surface soil within PMJM habitat, giving a spatial understanding of areas that may be used by individual PMJM or subpopulations of PMJM. More detail on the methodology of creating sitewide PMJM habitat patches can be found in Appendix A, Volume 2, Section 3.2 of the RI/FS Report.

PMJM habitat within the UWNEU was divided into five habitat patches, each containing habitat capable of supporting several PMJM. The patches vary in size and shape dependent on their location within the Walnut Creek drainage and discontinuity or habitat quality of surrounding patches. PMJM have been found in three of the five patches. The following is a brief discussion of the five patches within the UWNEU (Figure 1.5) and the reasons why each is considered distinct:

- **Patch #12A and #12B –** This patch contains habitat at the upper end of the A-series ponds on North Walnut Creek. The riparian zone is wide and complex, and supports wetlands and a mixture of willow shrublands and riparian woodlands. The boundaries of the patches correspond to earlier habitat delineation by the FWS (FWS 2005). Densities of PMJM are among the largest found on RFETS. Patch #12A and Patch #12B can be considered a single unit based on the hydrological connection via Pond A-2 and the fact that mice travel back and forth between the two areas (K-H 2000).

- **Patch #15 –** This is an isolated habitat patch between Ponds A-3 and A-4, and was identified as potential habitat based on vegetation mapped at an earlier date (USFWS 2005). PMJM have not been captured within this patch and no mice have been observed using this area via radio telemetry (K-H 2000). This patch contains intermixed areas of willow shrubs and short upland shrubs.

- **Patch #16 –** This patch contains a series of willow shrubs and wetlands below the B-5 dam. The patch is isolated from other areas of potential habitat by the terminal dam upstream and a long reach of Lower Walnut Creek that is typically dry. Water is present only when there are releases from the B-5 pond outlet works. No PMJM have ever been observed within this patch.

- **Patch #17 –** This patch supports the lower B-series PMJM population, with a relatively long and contiguous stretch of habitat between the B-4 and B-5 ponds. Given the flow-through design of the B-4 pond, this patch continually has water. Vegetation includes riparian shrublands and woodlands, with adjacent upland seep-wetlands, upland shrubs, and grasslands. The upstream boundary is the inlet of Pond B-3 and the lower boundary is the inlet to B-5.

- **Patch #18 –** This patch is found in the upper end of the B-series ponds on South Walnut Creek. A portion of this patch is located within the Industrial Area (IA). The patch is dominated by herbaceous wetland vegetation with three small areas of shrubs. Only a few individual PMJM have been observed using this area (K-H 2000). Recently, this area has been subjected to remedial activities and is recovering from physical disturbance. Reseeding and erosion control measures have been included. All areas disturbed by construction activities at the B-series ponds were graded to match existing slope contours. The areas were then ripped/disced and seeded. These areas were then covered with degradable erosion mats. Straw waddles were also deployed around the perimeters in downgradient areas.

- **Patch #9 –** This patch is partially located within UWNEU. Because there is a higher percentage of this patch in the Inter-Drainage Exposure Unit (IDEU), Patch #9 is evaluated as a patch within IDEU in Volume 5 of Appendix A of the RI/FS Report.

- **Patch #13 –** This patch is partially located within UWNEU. Because there is a higher percentage of this patch in the Lower Walnut Drainage Exposure Unit (LWNEU), Patch #13 is evaluated as a patch within LWNEU in Volume 8 of Appendix A of the RI/FS Report.

1.1.5 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface soil, subsurface soil, sediment, surface water, and groundwater samples were collected from the UWNEU. The data set for the CRA was prepared in accordance with data processing steps described in Appendix A, Volume 2, Attachment 2 of the RI/FS Report. Surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil are the media evaluated in the HHRA and ERA (Table 1.2). The sampling locations for these media are shown on Figures 1.6 and 1.7, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.7. Toxicity equivalence concentrations for 2,3,7,8-TCDD in surface soil/surface sediment, subsurface soil/subsurface sediment, and subsurface soil are presented in Tables 1.8 and 1.9. Potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) that were analyzed for but not detected, or were detected in less than 5 percent of the samples are presented in Attachment 1. Detection limits are compared to preliminary remediation goals (PRGs) and ecological screening levels (ESLs), and discussed in Attachment 1 (Tables A1.1 through A1.4). Only data from June 1991 to the present are used in the CRA because these data meet the approved analytical quality assurance/quality control (QA/QC) requirements.

In accordance with the CRA Methodology (DOE 2005a), only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a start depth less than or equal to 8 feet below ground surface (bgs) are used in the CRA. Subsurface soil and subsurface sediment data are limited to this depth because it is not anticipated that the WRW or burrowing animals will dig to deeper depths. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report.

The CRA analytical data set for the UWNEU is provided on a compact disc (CD) presented in Attachment 6. The CD includes the data used in the CRA as well as data not considered useable. Additional criteria for exclusion of data from use in the CRA are presented in Appendix A, Volume 2 of the RI/FS Report.

The sampling data used for the UWNEU HHRA and ERA are as follows:

- Combined surface soil/surface sediment data (HHRA);
- Combined subsurface soil/subsurface sediment data (HHRA);
- Surface soil data (ERA); and
- Subsurface soil data (ERA).

The data for these media are briefly described below.

In addition, because ECOPCs were identified for soil in this EU, surface water data were used in the ERA as part of the overall intake of ECOPCs by ecological receptor. The surface water data used in the ERA are summarized in Table 8.4. Surface water and sediment are assessed for ecological receptors on an Aquatic Exposure Unit (AEU) basis in Appendix A, Volume 15B of the RI/FS Report. An assessment of the surface water, groundwater-to-surface water, and volatilization pathways for human health are presented in Appendix A, Volume 2 of the RI/FS Report.

Surface Soil/Surface Sediment

The combined surface soil/surface sediment data set for the UWNEU consists of up to 199 samples that were analyzed for inorganics (152 samples), organics (135 samples), and radionuclides (199 samples) (Table 1.2). The data include sediment samples collected to depths down to 0.5 feet bgs. The sampling locations for surface soil and surface sediment are shown on Figure 1.6. All sample locations within the UWNEU were not necessarily analyzed for all analyte groups (see Table 1.3). Surface soil/surface sediment samples were collected in the UWNEU for several months from July 1991 through March 1995, and then again for several months from August 1997 through December 2004. The samples collected in 2004 were located on a 30-acre grid, as described in CRA SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected and composited from each 30-acre cell, one from each quadrant and one in the center, as described in the addendum (DOE 2004). Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples.

The data summary for detected analytes in surface soil/surface sediment for the UWNEU is presented in Table 1.3. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected, or were detected in less than 5 percent of the surface soil/surface sediment samples, is presented and discussed in Attachment 1.

Subsurface Soil/Subsurface Sediment

The combined subsurface soil/subsurface sediment data set for the UWNEU consists of up to 194 samples analyzed for organics, 160 for inorganics, and 174 for radionuclides (Table 1.2). The data include subsurface sediment samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. The sampling locations for subsurface soil and subsurface sediment are shown on Figure 1.7. All sample locations within the UWNEU were not necessarily analyzed for all analyte groups (see Table 1.4). Subsurface soil/subsurface sediment samples were collected in the UWNEU for several months from October 1991 through June 1994, and then again for several months from January 1998 through October 1999. Samples were again collected in May and June of 2002, and for several months from May 2004 through March 2005.

The data summary for subsurface soil/subsurface sediment in the UWNEU is presented in Table 1.4. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected, or were detected in less than 5 percent of the subsurface soil/subsurface sediment samples, is presented and discussed in Attachment 1.

Surface Soil

Data meeting the CRA requirements are now available for up to 75 surface soil samples within PMJM habitat collected in the UWNEU that were analyzed for inorganics (62 samples), organics (54 samples), and radionuclides (75 samples) (Table 1.2). The surface soil sampling locations within PMJM habitat are shown in Figure 1.5. Data meeting the CRA requirements are available for up to 117 surface soil samples collected in the UWNEU that were analyzed for inorganics (90 samples), organics (53 samples), and radionuclides (117 samples) (Table 1.2). The surface soil sampling locations for the UWNEU are shown on Figure 1.6. All sample locations within the UWNEU were not necessarily analyzed for all analyte groups (see Tables 1.5 and 1.6). The surface soil sampling density is highest at and near the Soil Dump Area (historical IHSS 156.2), but the entire site was covered during the 30-acre sampling. For the grid sampling, five individual samples were collected and composited from each 30-acre cell, one from each quadrant and one in the center, as described in the CRA SAP Addendum #04-01 (DOE 2004). Surface soil samples were collected in the UWNEU for several months from July 1991 through September 1994, and then again for several months from December 1998 through June 1999. Samples were again collected for several months from March 2001 through November 2004.

The data summary for detected analytes in UWNEU surface soil is presented in Table 1.5, while the data summary for the detected analytes for those samples within designated PMJM habitat is presented in Table 1.6. Radionuclides, organics, and inorganics were all detected in UWNEU surface soil samples. A summary of analytes that were not detected, or were detected in less than 5 percent of the surface soil samples, is presented and discussed in Attachment 1.

Subsurface Soil

The subsurface soil data set for the UWNEU consists of up to 138 samples. All 138 samples were analyzed for organics, 96 for inorganics, and 111 for radionuclides (Table 1.2). Subsurface soil sampling locations are shown on Figure 1.7. All sample locations within the UWNEU were not necessarily analyzed for all analyte groups (see Table 1.7). The majority of the subsurface soil sampling locations are located at or around historical IHSSs 156.2 and 216.1. Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. Subsurface soil samples were collected in the UWNEU for several months from October 1991 through June 1994, and then again for several months from January 1998 through October 1999. Samples were again collected for several months from May 2002 through June 2002, and from May 2004 through March 2005.

The data summary for detected analytes in subsurface soil for the UWNEU is presented in Table 1.7. Subsurface soil samples were analyzed for inorganics, organics, and radionuclides, and representatives from all three analyte groups were detected. A summary of analytes that were not detected, or were detected in less than 5 percent of the subsurface soil samples, is presented and discussed in Attachment 1.

1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2, Attachment 3 of the RI/FS Report. The adequacy of the data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. If the data do not meet the guidelines, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) are examined to determine if it is possible to make risk management decisions given the data limitations.

The findings from the data adequacy assessment applicable to all EUs are as follows:

The radionuclide and inorganic surface soil data are adequate for the purposes of the CRA.

For herbicides and pesticides, although the existing surface soil and sediment data may not meet the minimal data adequacy guidelines for each EU, there is considerable site-wide data, and pesticides and herbicides are infrequently detected at low concentrations, generally below PRGs and ESLs. This line of evidence indicates that it is possible to make risk management decisions without additional sampling for these analyte groups

For dioxins, although the existing surface soil and sediment data do not meet the minimal data adequacy guidelines for each EU, sample locations were specifically targeted for dioxin analysis at historical IHSSs in and near the former Industrial Area where dioxins may have been released based on process knowledge. Some of the dioxin concentrations at the historical IHSSs exceed the PRG and/or ESL. Additional samples were collected in targeted locations that represented low-lying or depositional areas where dioxin contamination may have migrated via runoff from these specific IHSSs. Results indicate that dioxin concentrations are not above the minimum ESL in sediment and dioxins are not detected in surface water. Therefore, although the existing data do not meet the minimal data adequacy guidelines for each EU/AEU, it is possible to make risk management decisions without additional sampling. However, unlike pesticides and herbicides where there is considerably more site-wide data, there is greater uncertainty in the overall risk estimates because fewer samples were collected at the site for dioxins.

Subsurface soil contamination is largely confined to historical IHSSs (that is, areas of known or suspected historical releases). These areas have been characterized to understand the nature and extent of potential releases. For historical IHSSs where subsurface soil samples were not collected for an analyte group, the presence of this type of subsurface contamination was not expected based on process knowledge. Therefore, the existing subsurface soil data are adequate for the purposes of the CRA.

The findings from the data adequacy report applicable to the UWNEU are as follows:

The number of surface soil and surface soil/surface sediment samples in the UWNEU for VOCs, SVOCs, and PCBs meet the data adequacy guideline.

A sediment sample was collected from Pond A-1 and Pond A-2 for dioxin analysis. The dioxin concentrations are not above the minimum ESL or the PRG in the sediment. Although this does not meet the minimal data adequacy guideline, as noted above, it is possible to make risk management decisions without additional sampling.

The spatial distribution of surface soil samples in the UWNEU for VOCs, SVOCs, and PCBs tends to be clustered near historical IHSSs in the adjacent Industrial Area. As a result, Tier 1 exposure point concentration calculations will tend to be conservative (i.e., overestimate exposures). With the addition of the sediment samples, the sample locations are more distributed throughout the EU. Therefore, the spatial distribution of the data are adequate for the purposes of the CRA.

The data adequacy guideline is met for radionuclides, metals, VOCs, SVOCs, and PCBs for PMJM patch #12, is met for all analyte groups except SVOCs for PMJM patch #18, and is met for radionuclides and metals for patch #17. The data adequacy guideline is not met for any analyte group for patches #15, and #16. The data for radionuclides, VOCs, SVOCs, and PCBs for all patches in the UWNEU indicate that the ESLs are not exceeded. Therefore, radionuclides and organics are not likely to be of concern in surface soil for the PMJM habitat patches. Only patches #15 and #16 do not meet the data adequacy guideline for metals. However, the more remote location of these patches from the historical IHSSs in and near the Industrial Area suggests that the metals data for the other patches in the EU (e.g. #12 and #18) are representative, if not biased high, for patches #15 and #16. Therefore, although the existing UWNEU PMJM habitat patch data do not meet the minimal data adequacy guidelines for the EU PMJM patches, it is possible to make risk management decisions without additional sampling.

Sampling locations are generally well distributed throughout the habitat patches, and therefore, meet the guideline for spatial representativeness.

The number of surface water samples in the UWNEU for radionuclides, metals, VOCs, SVOCs, and PCBs meet the data adequacy guideline. The sample locations are well distributed throughout the UWNEU, and therefore, meet the data adequacy guideline for spatial representativeness.

With the exception of PCBs, the surface water data are considered temporally representative. Although there are no current PCB data, the historical data indicate PCBs are not detected, and therefore, a temporal trend in concentrations is not expected. However, as discussed in Appendix A, Volume 15B2, Attachment 1 of the RI/FS report, professional judgment suggests PCBs have the potential to be ECOPCs in the North and South Walnut Creek Aquatic Exposure Units surface water had detection limits been lower, and therefore, there is some uncertainty in the risk assessment process with respect to PCBs in surface water.

For analytes not detected or detected in less than 5 percent of the samples in surface soil/surface sediment, 5 analytes have detection limits that exceed PRGs, however, the frequencies of PRG exceedance are either very low, or the analytes are not expected to be present in surface soil/surface sediment in the EU. All detection limits are below the PRGs/ESLs for subsurface soil/subsurface sediment and subsurface soil samples There are 14 analytes in surface soil where some percent of the detection limits exceed the lowest ESL. However, those analytes that have detection limits that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWNEU surface soil even if detection limits had been lower. Although some of the analytes would present a potential for adverse ecological effects if they were detected at their maximum detection limits, because they are not expected to be ECOPCs in UWNEU surface soil, uncertainty in the overall risk estimates is low (see Attachment 1 for a more detailed discussion).

1.3 Data Quality Assessment

A Data Quality Assessment (DQA) of the UWNEU data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Attachment 2, and an evaluation of the entire RFETS data set is presented in Appendix A, Volume 2 of the RI/FS Report. The quality of the laboratory results were evaluated for compliance with the CRA Methodology data quality objectives (DQOs) through an overall review of precision, accuracy, representativeness, and completeness, and comparability (PARCC) parameters. This review concluded that the data are of sufficient quality for use in this CRA, and the CRA DQOs have been met.

2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health contaminant of concern (COC) screening process is described in Section 4.4 of the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report (Section 2.2).

The human health COC selection process was conducted for surface soil/surface sediment and subsurface soil/subsurface sediment in the UWNEU. Results of the COC selection process are summarized below.

2.1 Contaminant of Concern Selection for Surface Soil/Surface Sediment

Detected PCOCs in surface soil/surface sediment samples (Table 1.3) are screened in accordance with the CRA Methodology to identify the COCs.

2.1.1 Surface Soil/Surface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in surface soil/surface sediment in accordance with the CRA Methodology.

The essential nutrient screen for analytes detected in surface soil/surface sediment is presented in Table 2.1. The screen includes PCOCs that are essential for human health and do not have toxicity criteria available. Table 2.1 shows the maximum detected concentrations (MDCs) for essential nutrients, daily intake estimates based on the MDCs, and dietary reference intakes (DRIs). The DRIs are identified in the table as recommended daily allowances (RDAs), recommended daily intakes (RDIs), adequate intakes (AIs), and upper limit daily intakes (ULs). The estimated daily maximum intakes based on the nutrients' MDCs and a surface soil/surface sediment ingestion rate of 100 milligrams (mg) per day (mg/day) are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for surface soil/surface sediment.

2.1.2 Surface Soil/Surface Sediment Preliminary Remediation Goals Screen

Table 2.2 compares MDCs and upper confidence limits (UCLs) to the WRW PRGs for each PCOC. If the MDC and the UCL are greater than the PRG, the PCOC is retained for further screening; otherwise, it is not further evaluated. Arsenic, benzo(a)pyrene, cesium-137, and radium-228 in surface soil/surface sediment had MDCs and UCLs that exceeded the PRGs, and were retained as PCOCs.

PRGs were not available for several PCOCs in surface soil/surface sediment. Analytes without PRGs are listed on Table 2.2 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.1.3 Surface Soil/Surface Sediment Detection Frequency Screen

Arsenic and benzo(a)pyrene were detected in more than 5 percent of surface soil/surface sediment samples and, therefore, were retained for further evaluation in the COC screen (Table 1.3). A detection frequency screen was not performed for cesium-137 and radium-228 in surface soil/surface sediment because all reported values for radionuclides are considered detects.

2.1.4 Surface Soil/Surface Sediment Background Analysis

Results of the background statistical comparison for arsenic, cesium-137, and radium-228 are presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic, cesium-137, and radium-228 (both UWNEU and background) are provided in Attachment 3. Arsenic is the only PCOC that was statistically greater than background at the 0.1 significance level, and it is evaluated further in the professional judgment section.

Following the CRA methodology, a statistical comparison to background is not performed for organics; therefore, benzo(a)pyrene is carried forward into the professional judgment evaluation.

2.1.5 Surface Soil/Surface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, pattern recognition comparisons to RFETS background and other background data sets, and risk potential for human health and ecological receptors. As discussed in Section 1.2 and Attachment 2, the sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

Based on the weight of evidence described in Attachment 3, arsenic in surface soil/ surface sediment in the UWNEU is not considered a COC because the weight of evidence supports the conclusion that arsenic concentrations in surface soil/surface sediment in the UWNEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

Benzo(a)pyrene is considered a COC in surface soil/surface sediment and is further evaluated in Sections 3.0 through 5.0.

2.2 Contaminant of Concern Selection for Subsurface Soil/Subsurface Sediment

Detected PCOCs in subsurface soil/subsurface sediment samples (Table 1.4) are screened in accordance with the CRA Methodology to identify the COCs.

2.2.1 Subsurface Soil/Subsurface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in subsurface soil/subsurface sediment in accordance with the CRA Methodology.

Essential nutrients without toxicity criteria that were detected in subsurface soil/ subsurface sediment in the UWNEU are compared to DRIs in Table 2.4. The estimated daily maximum intakes for these PCOCs, based on the nutrient's MDCs and a subsurface soil/subsurface sediment ingestion rate of 100 mg/day, are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for subsurface soil/subsurface sediment.

2.2.2 Subsurface Soil/Subsurface Sediment Preliminary Remediation Goal Screen

The PRG screen for detected analytes in subsurface soil/subsurface sediment is presented in Table 2.5. Radium-228 was the only PCOC with an MDC and UCL that exceeded the PRG. Therefore, radium-228 was retained as a PCOC.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed on Table 2.5 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.2.3 Subsurface Soil/Subsurface Sediment Detection Frequency Screen

The detection frequency screen is not performed for radium-228 in subsurface soil/ subsurface sediment because all reported values for radionuclides are considered detects.

2.2.4 Subsurface Soil/Subsurface Sediment Background Analysis

Results of the background statistical comparison for radium-228 is presented in Table 2.3 and discussed in Attachment 3. Box plots for radium-228 (both UWNEU and background) are provided in Attachment 3. Radium-228 concentrations were statistically greater than background at the 0.1 significance level; therefore, it is evaluated further in the professional judgment section.

2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, and pattern recognition. As discussed in Section 1.2 and Attachment 2, the sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

Based on the weight of evidence described in Attachment 3, radium-228 in subsurface soil/subsurface sediment in the UWNEU is not considered a COC because the weight of evidence above supports the conclusion that radium-228 concentrations in subsurface soil/subsurface sediment in the UWNEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. Benzo(a)pyrene was the only analyte in surface soil/surface sediment selected as a COC in the UWNEU and is further evaluated quantitatively. No analytes were selected as COCs in subsurface soil/subsurface sediment in the UWNEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented in Figure 2.1 of the CRA Methodology and is discussed in Appendix A, Volume 2 of the RI/FS Report, provides an overview of potential human exposures at RFETS for reasonably anticipated land use. Two types of receptors, the WRW and WRV, were selected for quantitative evaluation based on the SCM. Exposure point concentrations (EPCs) were calculated for the COCs identified and chemical intakes were estimated using the EPCs for the WRW and WRV receptors.

Tier 1 and Tier 2 EPCs were calculated for the one COC, benzo(a)pyrene, in surface soil/surface sediment for the UWNEU. Tier 1 EPCs are based on the UCLs of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. The methodology for these calculations is provided in Appendix A, Volume 2 of the RI/FS Report. Figure 3.1 shows the 30-acre grid used to calculate the Tier 2 EPCs. Table 3.1 presents the Tier 1 and Tier 2 EPCs for the UWNEU.

Chemical intakes for WRW and WRV exposure pathways were quantified for benzo(a)pyrene using the exposure factors listed in Tables 3.2 and 3.3, respectively. Additional information on the estimation of chemical intake is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

4.0 HUMAN HEALTH TOXICITY ASSESSMENT

Toxicity criteria are used in the risk calculations in Section 5.0. Tables 4.1 and 4.2 present the toxicity criteria (cancer slope factors [CSFs], reference doses [RfDs], and dermal absorption factors) for COCs at the UWNEU. Toxicity criteria are presented for the oral, inhalation, and dermal exposure pathways. Additional information on the human health toxicity assessment is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

5.0 HUMAN HEALTH RISK CHARACTERIZATION

Information from the exposure assessment and the toxicity assessment is integrated in this section to characterize risk to the WRW and WRV receptors. Quantitative risks for cancer and noncancer effects were estimated using the toxicity factors presented in the Toxicity Assessment (Section 4.0) and pathway-specific intakes defined in the Exposure Assessment (Section 3.0). Details of the risk characterization methods are provided in the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report.

5.1 Wildlife Refuge Worker (WRW)

This section presents the risk characterization for exposure to COCs at the UWNEU. The WRW receptor was evaluated for exposure to benzo(a)pyrene in surface soil/surface sediment. The risk estimates for exposure to benzo(a)pyrene are summarized in Table 5.1, while Attachment 4 contains the risk calculation tables.

5.1.1 Surface Soil/Surface Sediment

The WRW is evaluated for exposure to benzo(a)pyrene in surface soil/surface sediment by ingestion, inhalation, and dermal exposure (for organic COCs only). Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks for Tier 1 and Tier 2 EPCs are calculated and summarized in Tables 5.1 and 5.3. Noncancer hazards for benzo(a)pyrene were not calculated because noncancer toxicity values are not available for benzo(a)pyrene.

Risk Characterization Results Based on Tier 1 EPCs

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 1 EPC, is 1E-06 (Table 5.1). The primary risk driver is benzo(a)pyrene, which comprises 100 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route; however dermal exposure also has a significant contribution.

Risk Characterization Results Based on Tier 2 EPCs

The total cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 2 EPC, is 1E-06 (Table 5.1). The primary risk driver is benzo(a)pyrene, which comprises 100 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route; however dermal exposure also has a significant contribution.

5.1.2 Subsurface Soil/Subsurface Sediment

No COCs were selected in subsurface soil/subsurface sediment. Therefore, it is not necessary to perform a risk characterization for subsurface soil/subsurface sediment in the UWNEU.

5.1.3 WRW Total Risk and Hazards

Risk estimates are summed across media to develop an estimate for the total risk to a receptor. This approach is followed only if the COCs in different media exhibit comparable health effects. For the UWNEU, benzo(a)pyrene was selected as a COC for surface soil/surface sediment only. Total risk and hazards are summarized in Table 5.3. The surface soil/surface sediment risk estimates for the WRW result in an estimated total cancer risk of 1E-06 based on a Tier 1 EPC, and 1E-06 based on a Tier 2 EPC. Because benzo(a)pyrene was selected as a COC in only one medium, cumulative risks from exposure to multimedia are not calculated for the UWNEU.

5.2 Wildlife Refuge Visitor (WRV)

This section presents the results of the risk characterization for exposure of the WRV receptor to benzo(a)pyrene in surface soil/surface sediment at the UWNEU. Exposure to subsurface soil/subsurface sediment is not evaluated for WRV. The risk estimates for exposure to benzo(a)pyrene are summarized in Table 5.2. Attachment 4 contains the risk calculation tables.

5.2.1 Surface Soil/Surface Sediment

The WRV is evaluated for exposure to benzo(a)pyrene in surface soil/surface sediment by ingestion, inhalation, and dermal exposure (for organic COCs only). Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks for Tier 1 and Tier 2 EPCs are calculated and summarized in Tables 5.2 and 5.3, respectively. Noncancer hazards for benzo(a)pyrene were not calculated because noncancer toxicity values are not available for benzo(a)pyrene.

Risk Characterization Results Based on Tier 1 EPCs

The total cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 1 EPC, is 2E-06 (Table 5.2). The primary risk driver is benzo(a)pyrene, which comprises 100 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route; however dermal exposure also has a significant contribution.

Risk Characterization Results Based on Tier 2 EPCs

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 2 EPC, is 1E-06 (Table 5.2). The primary risk driver is benzo(a)pyrene, which comprises 100 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route; however dermal exposure also has a significant contribution.

5.3 Summary

Risks to the WRW and WRV were evaluated for potential exposure to benzo(a)pyrene in surface soil/surface sediment at the UWNEU. A summary of the cancer risks and noncancer hazards is presented in Table 5.3.

The results of the Tier 1 and Tier 2 risk characterizations indicate that estimated risks for the WRW and WRV are at the low end or are below the target risk range for COCs exhibiting carcinogenic effects (i.e., 1 x 10^{-6} to 1x 10^{-4}) (Table 5.3).

6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

There are various types of uncertainties associated with steps of an HHRA. General uncertainties common to the EUs are discussed in Appendix A, Volume 2 of the RI/FS Report. Uncertainties specific to the EU are described below.

6.1 Uncertainties Associated With the Data

Data adequacy for this CRA is evaluated and discussed in Appendix A, Volume 2 of the RI/FS Report. Although there are some uncertainties associated with the sampling and analyses conducted for surface soil/surface sediment and subsurface soil/subsurface sediment at the UWNEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the UWNEU were collected from 1991 through 2005. The CRA sampling and analysis requirements for the BZ (DOE 2004, 2005a) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. This sampling density is exceeded for most of the UWNEU given that there are up to 199 surface soil/surface sediment samples for the entire 403-acre EU. In subsurface soil/subsurface sediment, there are up to 194 samples in the UWNEU.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs for analytes eliminated as COCs because they were either not detected or had a low detection frequency (i.e., less than 5 percent). The detection limits were appropriate for the analytical methods used, and this is examined in greater detail in Attachment 1.

6.2 Uncertainties Associated With Screening Values

The COC screening analyses utilized RFETS-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 mg of surface soil/surface sediment for 230 days a year for 18.7 years. In addition, a WRW is assumed to be dermally exposed and to inhale surface soil and surface sediment particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs in the UWNEU because a WRW will not spend 100 percent of his or her time in this area. Exposure to subsurface soil and subsurface sediment is assumed to occur 20 days per year. The WRW PRGs for subsurface soil/subsurface sediment are also expected to conservatively estimate potential exposures because it is unlikely a WRW will excavate extensively in the UWNEU.

6.2.1 Uncertainties Associated with Potential Contaminants of Concern without Preliminary Remediation Goals

PCOCs for the UWNEU for which PRGs are not available are listed in Table 6.1.

Uncertainties associated with the lack of PRGs for analytes listed in Table 6.1 are considered small. The listed cations/anions and inorganics are not usually included in HHRAs because they are not expected to result in significant human health impacts. Many of the listed organics have a low detection frequency and, therefore, are not expected to affect the results of the HHRA. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for gross alpha and gross beta activities is also not expected to affect the results of the HHRA.

6.3 Uncertainties Associated with Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic in surface soil/surface sediment was eliminated as a COC based on professional judgment. There is no identified source or pattern of release in the UWNEU and the slightly elevated median value of arsenic in the UWNEU is most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of arsenic are naturally occurring and not due to site activities. Uncertainty associated with the elimination of this chemical as a COC is low.

Radium-228 was eliminated in subsurface soil/subsurface sediment based on professional judgment. There is no identified source or pattern of radium-228 release in the UWNEU, and the slightly elevated median value of radium-228 in the UWNEU is most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of radium-228 are naturally occurring and not due to site activities. Uncertainty associated with the elimination of this chemical as a COC is low.

6.4 Uncertainties Associated with Calculation of Risk

The Tier 1 UCL for the UWNEU surface soil/surface sediment benzo(a)pyrene data is 541 micrograms per kilogram (µg/kg), and the excess lifetime cancer risk is estimated to be 1E-06 (Table 5.1). Polynuclear aromatic hydrocarbons (PAHs) are ubiquitous in the environment and typical concentrations in urban soil range from 165 to 220 µg/kg (ATSDR 1995). Therefore, under similar exposure conditions as those evaluated for the WRW in the UWNEU, background risks from benzo(a)pyrene in urban soils would be approximately 3E-07 to 4E-07. Risks associated with typical PAH background levels in urban soils are equal to approximately 30 to 40 percent of the UWNEU risk estimates.

Therefore, potential risks from benzo(a)pyrene that is associated with site-related activities in the UWNEU may be over estimated.

6.5 Uncertainties Evaluation Summary

Evaluation of the uncertainties associated with the data and the COC screening processes indicates there is reasonable confidence in the conclusions of the UWNEU risk characterization.

7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process streamlines the ecological risk characterization for each EU by focusing the assessment on ECOIs that are present in the UWNEU. ECOIs are defined as any chemical detected in the UWNEU and are assessed for surface soils and subsurface soils. ECOIs for sediments and surface water are assessed in Appendix A, Volume 15B of the RI/FS Report. The ECOPC process is described in the CRA Methodology (DOE 2005a) and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. A detailed discussion of the ecological SCM, including the receptors of concern, exposure pathways, and endpoints used in the ERA for the UWNEU, is also provided in Appendix A, Volume 2 of the RI/FS Report.

The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. The most significant exposure pathways for ecological receptors at the UWNEU are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct ingestion of potentially contaminated media. For terrestrial plants and invertebrates, the most significant exposure pathway is direct contact with potentially contaminated soil.

The receptors of concern that were selected for assessment are listed in Table 7.1 and discussed in detail in Appendix A, Volume 2 of the RI/FS Report, and include representative birds and mammals in addition to the general plant and terrestrial invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the UWNEU, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC identification process consists of two separate evaluations, one for the PMJM receptor and one for non-PMJM receptors. The ECOPC identification process for the PMJM is conducted separately from non-PMJM receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517).

7.1 Data Used in the Ecological Risk Assessment

The following UWNEU data are used in the CRA:

- A total of 117 surface soil samples were collected and analyzed for inorganics (90 samples), organics (53 samples), and radionuclides (117 samples) (Table 1.2).

- A total of 138 subsurface soil samples were collected and analyzed for inorganics (96 samples), organics (138 samples), and radionuclides (111 samples) (Table 1.2).

A data summary is provided in Table 1.5 for surface soil and Table 1.7 for subsurface soil.

Sediment and surface water data for the UWNEU also were collected (Section 1.1.5) and are evaluated for the ERA in Appendix A, Volume 15B of the RI/FS Report. As discussed in Section 8.0, surface water EPCs are used in the risk model to estimate exposure via the surface water ingestion pathway. Three thousand one hundred and thirty-five distinct surface water samples were collected in the UWNEU and analyzed for inorganics (3,135 samples), organics (437 samples), and radionuclides (2,845 samples).

As described in Section 1.1.4, there are 75 sample locations occurring in PMJM habitat within the UWNEU. Some of the sample locations are located outside of the UWNEU boundary but are within designated patches that are a part of UWNEU (see Section 1.1.4). Surface soil samples were collected and analyzed for inorganics (62 samples), organics (54 samples), and radionuclides (75 samples). A data summary is provided in Table 1.6 for surface soil in PMJM habitat. Sampling locations and PMJM habitat patches within the UWNEU are shown on Figure 1.5.

7.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for non-PMJM and PMJM receptors in accordance with the sequence presented in the CRA Methodology.

7.2.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process, the MDCs of ECOIs in surface soil were compared to receptor-specific no observed adverse effect level (NOAEL) ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

Non-PMJM Receptors

The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 7.1. The results of the NOAEL ESL screening analyses for all receptor types are summarized in Table 7.2. Analytes with a "Yes" in any of the "Exceedance" columns in Table 7.2 are evaluated further.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 7.1 and 7.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity (UT) in Section 10.0 along with the potential impacts to the risk assessment.

PMJM Receptors

The NOAEL ESLs for PMJM receptors were compared to the MDCs of ECOIs in surface soil collected from PMJM habitat (Table 7.3). The MDCs in surface soil that exceed the NOAEL ESLs are identified in Table 7.3 with a "Yes" under the column heading "EPC>PMJM ESL?"

Analytes for which a PMJM NOAEL ESL is not available are identified with a "N/A" in Table 7.3 under the column heading "PMJM NOAEL ESL." These analytes are discussed in the uncertainty section (Section 10.0) as ECOIs with UT.

7.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, then population-level risks are considered highly unlikely and the ECOI is not further evaluated. None of the chemicals detected in surface soil at the UWNEU that were retained after the NOAEL ESL screening step had a detection frequency less than 5 percent. Therefore, no ECOIs were excluded based on the detection frequency evaluation for surface soil in the UWNEU.

7.2.3 Surface Soil Background Comparisons

The ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where available. The background comparison is presented in Tables 7.4 and 7.5 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Appendix A, Volume 2 of the RI/FS Report.

Non-PMJM Receptors

The results of the background comparisons for the non-PMJM receptors are presented in Table 7.4. The analytes listed as being retained as ECOIs in Table 7.4 are evaluated further using upper-bound EPCs in the following section.

PMJM Receptors

The background comparison for PMJM receptors is performed using the same methods as for non-PMJM receptors, but the EU data set is restricted to soil samples from within PMJM areas. Table 7.5 presents the results of the PMJM comparison to background. Attachment 3 presents further discussion of the PMJM background analysis. The analytes listed as '"yes" on Table 7.5 are further evaluated in the professional judgment evaluation.

7.2.4 Exposure Point Concentration Comparisons to Threshold ESLs

The ECOIs retained after completion of all previous evaluations for non-PMJM receptors were then compared to threshold ecological screening levels (tESLs) using upper-bound EPCs specific to small and large home-range receptors. The calculation of EPCs is described in Attachment 3 and Appendix A, Volume 2 of the RI/FS Report.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.6. The EPC for small home-range receptors is the 95 percent UCL of the 90th percentile (upper tolerance limit [UTL]), or the MDC in the event that the UTL is greater than the MDC. The EPC for large home-range receptors is the UCL of the mean, or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

Large home-range receptors, such as coyote and mule deer, are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

The upper-bound EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.7. Analytes that exceed the limiting tESLs are further evaluated by comparing them to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.8, and analytes exceeding limiting tESLs for large home-range receptors are compared to receptor-specific tESLs in Table 7.9.

Chemicals that exceed any tESLs (if available) are assessed in the professional judgment evaluation. Any analyte/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk assessment.

7.2.5 Surface Soil Professional Judgment Evaluation

Non-PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, aluminum and boron in surface soil at the UWNEU were not considered ECOPCs for non-PMJM receptors and are not further evaluated quantitatively.

Antimony, copper, molybdenum, nickel, silver, tin, vanadium, zinc, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total polychlorinated biphenyls (PCBs) were identified as ECOPCs and retained for further evaluation in the risk characterization.

PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, all analytes except selenium that passed through the previous screening steps for PMJM receptors were identified as ECOPCs and retained for further evaluation in the risk characterization.

Antimony, nickel, tin, vanadium, and zinc were identified as ECOPCs and retained for further evaluation in the risk characterization.

7.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

The ECOPC identification process for surface soil is summarized below for non-PMJM receptors and PMJM receptors.

Non-PMJM Receptors

Most inorganic, organic, and radionuclide surface soil ECOIs for non-PMJM receptors in the UWNEU were eliminated from further consideration in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWNEU surface soils was not statistically greater than those from background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs and are presented in Table 7.10.

A summary of the ECOPC screening process for non-PMJM receptors is presented in Table 7.10. Receptors of potential concern for each ECOPC are also presented. The ECOPC/receptor pairs are evaluated further in Section 8.0 (Ecological Exposure Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

PMJM Receptors

ECOIs in surface soil in PMJM habitat located within the UWNEU were evaluated in the ECOPC identification process. Most ECOIs were removed from further evaluation in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the NOAEL ESL for PMJM; 2) no NOAEL ESLs were available (these ECOIs are discussed in Section 10.0); 3) the ECOI concentrations within the PMJM habitat in UWNEU were not statistically greater than those from background surface soils; or 4) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs for PMJM receptors and are presented in Table 7.11.

The results of the ECOPC identification process for the PMJM are summarized in Table 7.11. The ECOPC/PMJM pairs are evaluated further in Section 8.0 (Ecological Exposure Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

7.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

Subsurface soil sampling locations for soil collected at a starting depth of 0.5 to 8 feet bgs in the UWNEU are identified on Figure 1.7. A data summary is presented in Table 1.7 for subsurface soil less than 8 feet deep.

7.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology indicates subsurface soil must be evaluated for those ECOIs that have greater concentrations in subsurface soil than in surface soil. As a conservative step, subsurface soil is evaluated for all EUs regardless of the presence/absence of a change in concentrations from surface soil and subsurface soil. The MDCs of ECOIs in subsurface soil were compared to NOAEL ESLs for burrowing receptors (Table 7.12). ECOIs with MDCs greater than the NOAEL ESL for the prairie dog are further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for some analytes, and these are identified as “N/A” in Table 7.12. These constituents are considered ECOIs with uncertain toxicity (UT) and are discussed in the uncertainty analysis (Section 10.0).

7.3.2 Subsurface Soil Detection Frequency Evaluation

The ECOPC identification process for burrowing receptors includes an evaluation of detection frequency for each ECOI retained after the NOAEL ESL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. The detection frequencies for chemicals in subsurface soil are presented in Table 1.7. None of the chemicals in subsurface soil at the UWNEU that were retained after the NOAEL ESL screening step had a detection frequency of less than 5 percent. Therefore, no ECOIs were eliminated from further evaluation based on low detection frequencies for subsurface soil in the UWNEU.

7.3.3 Subsurface Soil Background Comparison

The ECOIs retained after the ESL screening and detection frequency evaluation were compared to site-specific background concentrations where available. The background comparisons are presented in Table 7.13 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Attachment 3.

Analyses were conducted to assess whether arsenic and nickel in UWNEU subsurface soil are statistically greater than those in sitewide background surface soil at the 0.1 level of significance. The results of the statistical comparisons of the UWNEU data to background data indicate that site concentrations of arsenic and nickel in UWNEU subsurface soil are not statistically greater than background concentrations. These ECOIs were eliminated as ECOPCs and were not evaluated further.

Statistical comparisons could not be completed for selenium because detection frequencies for either the background data set or UWNEU data sets were too low. Selenium is evaluated further using upper-bound EPCs in the following section.

7.3.4 Exposure Point Concentration Comparisons to Threshold ESLs

ECOIs retained after all previous evaluations for burrowing receptors are compared to tESLs using EPCs specific to small home-range receptors. The calculation of upper-bound EPCs is discussed in the CRA Methodology (DOE 2005a).

Because only selenium was retained following the background analysis step, statistical concentrations for selenium are presented in Table 7.14. The EPC comparison to tESLs for burrowing receptors is presented in Table 7.15. The subsurface soil UTL for selenium is lower than the tESL for the prairie dog receptor; therefore, selenium was not evaluated further.

7.3.5 Subsurface Soil Professional Judgment

ECOIs with subsurface soil concentrations that exceed NOAEL ESLs, which have been detected in more than 5 percent of samples, that have concentrations statistically higher than background data, and which exceed tESLs are subject to a professional judgment evaluation. However, no ECOIs had subsurface soil concentrations that exceeded tESLs; therefore, no weight-of-evidence, professional judgment evaluation was needed for subsurface soil in the UWNEU.

7.3.6 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the UWNEU were eliminated from further consideration in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than NOAEL ESL for the burrowing receptor; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWNEU subsurface soils was not statistically greater than those in background subsurface soils; or 4) the upper-bound EPC was less than the tESL. The results of the subsurface soil ECOPC identification process for burrowing receptors are summarized in Table 7.16.

7.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the UWNEU were evaluated in the ECOPC identification process for non-PMJM receptors, PMJM receptors, and burrowing receptors. Antimony, copper, molybdenum, nickel, silver, tin, vanadium, zinc, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total PCBs were identified as ECOPCs for selected non-PMJM receptors (Table 7.10). Antimony, nickel, tin, vanadium, and zinc were identified as ECOPCs for the PMJM (Table 7.11). No chemicals were identified as ECOPCs for burrowing receptors (Table 7.16). No other ECOIs were retained past the professional judgment step of the ECOPC identification process for any other receptor group (non-PMJM receptors, PMJM receptors, or burrowing receptors).

8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The list of ECOPC/receptor pairs of potential concern (Table 8.1) represents those media, chemicals, and receptors in the UWNEU that require further assessment. The characterization of risk defines a range of potential exposures to site receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs, as well as the uncertainties associated with the risk characterization. This section provides the estimation of potential exposure to surface soil ECOPCs for the receptors identified in Section 7.0 and Table 8.1. Exposure to ECOPCs via the ingestion of surface water is also considered a potentially significant exposure route as presented in the CRA Methodology (DOE 2005a). Details of the two exposure models, concentration-based exposure and dosage-based exposure, are presented in Appendix A, Volume 2 of the RI/FS Report.

8.1 Exposure Point Concentrations

Surface soil EPCs for all non-PMJM receptors were calculated using both Tier 1 and Tier 2 methods, as described in the CRA Methodology. Tier 1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set, and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. The 30-acre grid used for the Tier 2 calculations is shown in Figure 8.1. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 8.2. The methodology for the calculation of Tier 2 statistics is provided in Appendix A, Volume 2 of the RI/FS Report.

Surface soil EPCs for PMJM receptors were calculated for each PMJM habitat patch, assuming that all samples were randomly located and weighted equally. The habitat patches showing sample locations exceeding maximum background, the NOAEL ESL, or three times the NOAEL ESL are shown for ECOPCs in Figure 8.2 (antimony), Figure 8.3 (nickel), Figure 8.4 (tin), Figure 8.5 (vanadium), and Figure 8.6 (zinc). The UCL concentrations for each ECOPC were used as EPCs to calculate HQs. The UCL was not used if there were not sufficient numbers of samples to calculate this value or if it exceeded the MDC. The surface soil EPCs for each PMJM patch are presented in Table 8.3. The ECOPCs shown in Table 8.3 represent ECOPCs with patch-specific MDCs greater than their respective ESLs. All ECOPCs that are not detected in a specific patch or at concentrations less than their ESLs are excluded from the table.

The surface water EPCs were calculated for ECOIs that were identified as soil ECOPCs using the same statistical basis as determined for the soil ECOPCs. For example, if the soil EPC statistic was the UCL, then the UCL concentration in surface water (total values only) was calculated as described for soils and selected as the EPC. Surface water EPCs for all ECOPCs are presented in Table 8.4. All surface water data are provided on CD in Attachment 6.

8.2 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology (DOE 2005a) and are presented in Table 8.5 for the receptors of potential concern carried forward in the ERA for the UWNEU.

8.3 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative bioaccumulation factors (BAFs) were identified in the CRA Methodology (DOE 2005a). These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation.

8.4 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 8.1. The estimates use the default exposure parameters and BAFs presented in Appendix B of the CRA Methodology (DOE 2005a) and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated using upper-bound EPCs including the Tier 1 and Tier 2 UTLs and UCLs where appropriate.

Non-PMJM Receptors

The intake and exposure estimates for ECOPC/non-PMJM receptor pairs are presented in Attachment 4. Except for plants and invertebrates, a summary of the exposure estimates is presented in Table 8.6.

- Antimony – Default exposure estimates for deer mouse (herbivore and insectivore), prairie dog, and coyote (generalist and insectivore);
- Copper – Default exposure estimates for the mourning dove (herbivore and insectivore);
- Molybdenum – Default exposure estimates for the deer mouse (insectivore);
- Nickel – Default exposure estimates for mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore);
- Nickel – Refined exposure estimates for deer mouse (insectivore);

- Tin – Default exposure estimates for American kestrel, mourning dove (herbivore and insectivore), and deer mouse (insectivore);

- Vanadium – Default exposure estimates for the deer mouse (herbivore and insectivore);

- Zinc – Default exposure estimates for the American kestrel, mourning dove (herbivore and insectivore), and deer mouse (insectivore);

- Bis(2-ethylhexyl)phthalate – Default exposure estimates for the American kestrel and mourning dove (insectivore);

- Di-n-butylphthalate – Default exposure estimates for the American kestrel and mourning dove (insectivore); and,

- Total PCBs – Default exposure estimates for the mourning dove (insectivore).

PMJM Receptors

The intake and exposure estimates for ECOPC/PMJM receptor pairs by patch are presented in Attachment 4 and are summarized in Table 8.7 for:

- Antimony – default exposure estimates;

- Nickel – default and refined exposure estimates;

- Tin – default exposure estimates;

- Vanadium – default exposure estimates; and,

- Zinc – default exposure estimates.

9.0 ECOLOGICAL TOXICITY ASSESSMENT

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 8.0 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs employed in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response for a group of exposed organisms may first begin to be significantly greater than the response for unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology (DOE 2005a).

TRVs for ECOPCs identified for UWNEU were obtained from the CRA Methodology. The pertinent TRVs for the UWNEU are presented for terrestrial plants in Table 9.1 and for birds and mammals in Table 9.2.

10.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology (DOE 2005a) and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the UWNEU.

Potential risks to terrestrial plants, invertebrates, birds, and mammals are evaluated using a hazard quotient (HQ) approach. An HQ is the ratio of the estimated exposure of a receptor to a TRV that is associated with a known level of toxicity, either a no effect level (NOAEL or NOEC) or an effect level (LOAEL or lowest observed effect concentration [LOEC]):

$$HQ = Exposure / TRV$$

As described in Section 8.0, the units used for exposure and TRV depend upon the type of receptor evaluated. For plants and invertebrates, exposures and TRVs are expressed as concentrations (mg/kg soil). For birds and mammals, exposures and TRVs are expressed as ingested doses (mg/kg BW/day).

In general, if the NOAEL-based HQ is less than 1, then no adverse effects are predicted. If the LOAEL-based HQ is less than 1 but the NOAEL-based HQ is above 1, then some adverse effects are possible, although it is expected that the magnitude and frequency of the effects will usually be low (assuming the magnitude and severity of the response at the LOAEL are not large and the endpoint of the LOAEL accurately reflects the assessment endpoints for that receptor). If the LOAEL-based HQ is greater than or equal to 1, then the risk of an adverse effect is of potential concern, with the probability and/or severity of effect tending to increase as the value of the HQ increases.

When interpreting HQ results for non-PMJM ecological receptors, it is important to remember that the assessment endpoint to non-PMJM receptors is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. For threatened and endangered species, such as the PMJM, the interpretation of HQ results is based on potential risks to individuals rather than to populations.

HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. The NOAEL and NOEC TRVs along with default screening-level exposure assumptions are first used to calculate HQs. However, these no effects HQs are typically considered as screening level results and do not necessarily represent realistic risks for the site. EPA risk assessment guidance (EPA 1997) recommends a tiered approach to evaluation, and following the first tier of evaluation "the risk assessor should review the assumptions used (e.g., 100 percent bioavailability) against values reported in the literature (e.g., only up to 60 percent for a particular contaminant), and consider how the HQs would change if more realistic conservative assumptions were used instead." Accordingly, LOAEL and threshold TRVs are also used in this evaluation to calculate HQs. Where LOAEL HQs greater than 1 are calculated using default exposure assumptions, and the uncertainty analysis indicates that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are calculated.

10.1 Chemical Risk Characterization

Chemical risk characterization uses quantitative methods to evaluate potential risks to ecological receptors. In this risk assessment, the quantitative method used to characterize chemical risk is the HQ approach. As noted above, HQs are usually interpreted as follows:

HQ Values		Interpretation of HQ Results
NOAEL-based	LOAEL-based	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low-level risk[a]
> 1	> 1	Potential adverse effects

[a]Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, described below.

- **EPCs.** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (IHSS/PAC/UBCs), EPCs calculated using the Tier 1 approach (which assumes that all samples are randomly spread across the EU and are weighted equally) may tend to yield an EPC that is biased high. For this reason, a Tier 2 area-weighting approach was used to derive additional EPCs that help compensate for this potential bias. HQs were always calculated based on both Tier 1 and Tier 2 EPCs for non-PMJM receptors. No Tier 2 EPCs were calculated for PMJM receptors due to the limited size of their habitat.

- **BAFs.** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. To estimate more typical tissue concentrations, where necessary, an alternative exposure scenario calculated total chemical intake using a 50th percentile (median) BAF, and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (Eco-SSL) guidance (EPA 2005).

- **TRVs.** The CRA Methodology used an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection process. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed on a chemical-by-chemical basis in the following subsections. When an alternative TRV is identified, the chemical-specific subsections provide a discussion of why the alternative TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternative TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs were evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs, and background risk are presented for each chemical in Attachment 5. Where uncertainties were deemed to be high, Attachment 5 provides alternative BAFs and/or TRVs that are then incorporated into the risk characterization as appropriate.

HQs calculated using the default BAFs and HQs with the Tier 1 and Tier 2 EPCs are provided in Tables 10.1 and 10.2 for each ECOPC/receptor pair. Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs were calculated. Since the default HQs are generally the most conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

Where LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicates that median BAFs and/or additional TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are calculated and presented in Tables 10.1 and 10.2 as appropriate.

The selection of which EPC (e.g., UTL or UCL) is of primary importance depends on the type of receptor and the relative home-range size. Only the UTL EPC is provided in Table 10.1 for small home-range receptors and only the UCL is provided for large home-range receptors. The patch-specific UCL is provided in Table 10.2 for the PMJM receptors.

All calculated exposure estimates and HQ values are also provided in Attachment 4. These include the default and refined HQs if needed. The results for each ECOPC are discussed in more detail below.

The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimations and other lines of evidence to evaluate potential chemical effects on ecological receptors in the UWNEU following accelerated actions at RFETS. Information considered in the risk description includes receptor groups potentially affected; type of TRV exceeded (e.g., NOAEL versus LOAEL); relation of EU concentrations to other criteria such as EPA Eco-SSLs; and risk above background conditions. In addition, other site-specific and regional factors are considered such as the use of a given ECOPC within the EU related to historical RFETS activities; comparison of ECOPC concentrations within the UWNEU to the rest of the RFETS site as it relates to background; and/or comparison to regional background concentrations.

10.1.1 Antimony

Antimony HQs for terrestrial plants, deer mouse (herbivore and insectivore), prairie dog, and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.1 shows the spatial distribution of antimony in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #17 and #18) are presented in Table 10.2.

For non-PMJM vertebrate receptors, only the deer mouse (insectivore) had LOAEL HQs greater than 1 indicating a potential for adverse effects. In addition, the terrestrial plant had a LOEC HQ greater than 1 indicating that there may be a potential for adverse effects in plants. The uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties associated with the antimony ESL for plants and with the upper-bound BAFs and default TRVs used in the deer mouse (insectivore) calculations. A refined analysis could not be performed because additional ESLs for plants were not available and a median soil-to-invertebrate BAF and additional TRVs were also not available for the deer mouse (insectivore). For PMJM receptors, a LOAEL HQ greater than 1 (HQ = 2) was calculated in Patch #18 using the default HQ calculations. No additional HQs were calculated because of the lack of a median BAF or an alternative TRV for a refined analysis.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Antimony – Risk Description

Antimony was identified as an ECOPC for terrestrial plants, the deer mouse (herbivore and insectivore), prairie dog, coyote (generalist and insectivore), and PMJM receptors (Patches #17 and #18). Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, HQs were greater than 1 using the Tier 1 and Tier 2 UTLs (Table 10.1). However, Efroymson et al. (1997a) places low confidence in the TRV because there are no primary reference data showing toxicity to plants and the ESL is based on unspecified toxic effects. No additional TRVs were available in the literature for a refined analysis. The potential for risk to terrestrial plant populations in the UWNEU from exposure to antimony in surface soils is likely to be low to moderate but there is a high level of uncertainty due to the lack of confidence in the toxicity information on the effects of antimony on plants.

Non-PMJM Receptors – Small Home Range

Potential risks to vertebrate non-PMJM receptors were evaluated and HQs are presented in Table 10.1. Using the Tier 1 EPCs, NOAEL HQs greater than or equal to 1 were calculated for the deer mouse (herbivore and insectivore) and prairie dog. NOAEL HQs greater than 1 were also calculated using Tier 2 EPCs for the deer mouse (herbivore and insectivore) but were less than 1 for the prairie dog.

Only the deer mouse (insectivore) had LOAEL HQs greater than 1 using both Tier 1 and Tier 2 EPCs (HQs = 2). Therefore, the potential for adverse effects to populations of small mammals such as the deer mouse (herbivore) and prairie dog are likely to be low. However, risks to the deer mouse (insectivore) using the default HQ calculations may potentially be significant and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Antimony samples were available from 28 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 61 percent of the grid cells, and no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to antimony.

There is considerable uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). A median BAF and additional TRVs were unavailable for a refined analysis. Therefore, the potential for adverse effects to populations of small mammals such as the deer mouse (insectivore) are likely to be low to moderate. However, no LOAEL HQs were greater than 1 in the grid analysis for the deer mouse (insectivore) and there is considerable uncertainty or low confidence in the default risk analysis.

Non-PMJM Receptors – Large Home Range

Potential risks to vertebrate large home-range, non-PMJM receptors were evaluated and HQs are presented in Table 10.1. NOAEL HQs greater than or equal to 1 were calculated for the coyote (generalist and insectivore using the Tier 1 and Tier 2 UCLs.

No LOAEL HQs greater than 1 were calculated for either the coyote (generalist) or the coyote (insectivore). Because no HQs greater than 1 were calculated using any effects-based TRV, the potential for adverse effects to populations of large home-range receptors such as the coyote are likely to be low.

PMJM Receptor

Antimony was not detected in PMJM habitat Patches #12 or #15 and, therefore, was not evaluated as an ECOPC in either patch. Antimony was identified as an ECOPC in Patches #17 and #18. Sample locations within PMJM habitat and a comparison to the PMJM ESL are shown in Figure 8.2.

NOAEL HQs were greater than 1 in both Patch #17 and #18. The LOAEL HQ was also greater than 1 in Patch #18 (HQ = 2) but less than 1 in Patch #17. Therefore, the potential for adverse effects to PMJM receptors within Patch #18 are likely to be low to moderate but somewhat elevated over Patch #17 where risks are likely to be low.

Section 1.4 discussed the quality of habitat and presence/absence of PMJM in that habitat. Patches #17 and #18 are both marginal habitat areas that have historically only supported several PMJM. Given the elevated HQs calculated using the default TRVs, risks to these PMJM cannot be discounted; however, the risk may be somewhat overstated. The uncertainty section also discussed the likely overestimation of the predicted invertebrate tissue concentration, also indicating that the intake calculated and subsequent risk for the PMJM may be overestimated. Given that the LOAEL HQ is only equal to 2 and there is considerable uncertainty or low confidence in the default risk analysis, risks to PMJM receptors within Patch #18 are to likely be low but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWNEU are likely low.

10.1.2 Copper

Copper HQs for the mourning dove (herbivore and insectivore) are presented in Table 10.1. Copper was not identified as an ECOPC in the UWNEU for any other receptors. Figure 10.2 shows the spatial distribution of copper in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Copper Risk Description

Copper was identified as an ECOPC for the mourning dove (herbivore and insectivore) receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs calculated using Tier 1 and Tier 2 EPCs were equal to 1 for the mourning dove (herbivore). NOAEL HQs for the mourning dove (insectivore) were greater than 1 using both Tier 1 and Tier 2 EPCs (HQs = 2).

All LOAEL HQs were less than 1 for both receptors. Therefore, the potential for adverse effects to populations of non-PMJM small home-range receptors such as the mourning dove (herbivore and insectivore) are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL, threshold, and LOAEL TRVs were used in the HQ calculations. Copper samples were available from 28 grid cells (Figure 10.2). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to copper.

10.1.3 Molybdenum

Molybdenum HQs for terrestrial plants and deer mouse (insectivore) are presented in Table 10.1. Figure 10.3 shows the spatial distribution of molybdenum in relation to the deer mouse (insectivore) ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Molybdenum – Risk Description

Molybdenum was identified as an ECOPC for terrestrial plants and the deer mouse (insectivore) receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, HQs were equal to 1 using the Tier 1 and Tier 2 EPCs (Table 10.1). Due to the lack of confidence in the toxicity information on the effects of molybdenum on plants and HQs equal to 1 using both EPCs, it is unlikely that molybdenum presents a potential for adverse effects to terrestrial plant populations in the UWNEU.

Non-PMJM Receptors – Small Home Range

For the deer mouse (insectivore), NOAEL HQs were equal to 1 using both the Tier 1 and Tier 2 EPCs. All LOAEL HQs were less than 1 using both EPCs. Because no HQs greater than 1 were calculated using any effects-based TRV, the potential for adverse effects to non-PMJM small home-range receptors such as the deer mouse (insectivore) is likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Molybdenum samples were available from 28 grid cells (Figure 10.3). NOAEL HQs greater than 1 were calculated in 25 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to molybdenum.

10.1.4 Nickel

Nickel HQs for the mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.4 shows the spatial distribution of nickel in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #12, #15, #17, and #18) are presented in Table 10.2.

For non-PMJM receptors, only the deer mouse (insectivore) had LOAEL HQs greater than 1, indicating a potential for adverse effects. The uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties in the nickel risk calculations based on both the upper-bound BAFs and default TRVs used in the deer mouse (insectivore) risk calculations. For this reason, refined risk calculations for the deer mouse (insectivore) using a median soil-to-invertebrate BAF and additional TRVs was performed. The resulting HQs are presented in Table 10.1

For PMJM receptors, NOAEL and LOAEL HQs greater than 1 were calculated using the UCL EPC in all four patches within UWNEU, indicating a potential for adverse effects to the PMJM receptor. However, as discussed above, the uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties in the nickel risk calculations based on both the upper-bound BAFs and default TRVs. Therefore, a refined analysis for the PMJM receptor was performed using a median BAF and additional TRVs. The resulting HQs are presented in Table 10.2

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Nickel – Risk Description

Nickel was identified as an ECOPC for the mourning dove (insectivore), deer mouse (herbivore and insectivore), PMJM, and coyote (generalist and insectivore). Refined HQs were calculated for the deer mouse (insectivore) and PMJM using a median soil-to-invertebrate BAF and additional TRVs. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore) using the default risk model (Table 10.1). NOAEL HQs were equal to 1 for the deer mouse (herbivore). LOAEL HQs were less than 1 for all receptors except the deer mouse (insectivore). Therefore, the potential for adverse effects to populations of the mourning dove (insectivore) and deer mouse (herbivore) are likely to be low. Risks to the deer mouse (insectivore) using the default HQ calculations may be potentially significant and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Nickel samples were available from 28 grid cells (Figure 10.4). NOAEL HQs greater than 10 were calculated in 100 percent of the grid cells. LOAEL HQs greater than 1 but less than 5 were also calculated in all grid cells for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that risks from average exposure to sub-populations of insectivorous small mammals results in low to moderate risk from exposure to nickel and requires further evaluation.

The uncertainty analysis discussed the potential for risks at UCL and UTL background soil concentrations. For the deer mouse (insectivore), LOAEL HQs in background (UTL and UCL HQs = 3) are similar to those calculated for UWNEU surface soils. These results indicate that risks to insectivorous deer mouse populations within UWNEU are similar to those offsite.

The uncertainty analysis indicated that exposure to the deer mouse (insectivore) may be overestimated based on the use of upper-bound BAFs. Alternative intake rates were calculated for those receptors ingesting invertebrates in their diet. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). Table 10.1 presents HQs calculated using the identical default risk model but with a median BAF rather than the conservative 90^{th} percentile BAF. The deer mouse (insectivore) had a NOAEL HQ greater than 1 using the Tier 1 EPC (HQ = 11) and the Tier 2 EPC (HQ = 9). However, LOAEL HQs were less than or equal to 1 using both EPCs. When the TRVs from Sample et al. (1996) were used instead of the default TRVs, no HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV.

The refined analysis supports the conclusion that the default HQs are likely overestimated and risks are low, not low to moderate as indicated by the default HQ results. In addition, background risk evaluations also indicated similar HQs for the deer mouse (insectivore) using the default HQ calculations. Therefore, the potential for adverse effects are expected to be low to populations of the deer mouse (insectivore).

Non-PMJM Receptors – Large Home Range

NOAEL HQs using default risk models were greater than 1 for the coyote (generalist and insectivore). LOAEL HQs for both receptors were less than 1 for all exposure scenarios. Because risks are classified as low using the more conservative default HQ calculations, no alternative HQs were calculated and the potential for adverse effects to populations of large home-range receptors such as the coyote are likely to be low.

PMJM Receptor

For the PMJM receptor, NOAEL HQs were greater than 1 in all four patches. LOAEL HQs were also greater than 1 in all four patches (HQs = 3). Therefore, risks to the PMJM using the default HQ calculations may potentially be significant and require further evaluation.

The uncertainty analysis discussed the potential for risks at UCL background soil concentrations. For the PMJM, risks calculated using the background UCL as the EPC indicate potential adverse effects, with the NOAEL HQ equal to 20 for the UCL. LOAEL HQs in background using the UCL are the same as those calculated for UWNEU surface soils (HQs = 3). These results indicate that risks to insectivorous deer mouse populations within UWNEU are similar to those offsite.

No LOAEL HQs greater than 1 were calculated using the median soil-to-invertebrate BAF in all four patches. In addition, no HQs (NOAEL or LOAEL) were greater than 1 for any of the four patches when using the additional NOAEL or LOAEL TRV coupled with the median BAF in the risk calculation. Similarly, no HQs (NOAEL or LOAEL) were greater than 1 when using the upper-bound soil-to-invertebrate BAF coupled with the additional NOAEL or LOAEL TRV in the risk calculation.

The refined analysis indicates that the potential for adverse effects to the PMJM receptor are low in all four patches because HQs calculated in those patches are similar to those calculated using background data and LOAEL HQs were less than 1 for all patches when the median soil-to-invertebrate BAF and additional TRVs were used in the risk calculations. Based on the uncertainty analysis, the potential for adverse effects are expected to be low for the PMJM in all four patches.

10.1.5 Silver

Silver HQs for terrestrial plants are presented in Table 10.1. Figure 10.5 shows the spatial distribution of silver in relation to the terrestrial plant ESL, and also presents the data used in the calculation of Tier 2 EPCs.

The terrestrial plant receptors had HQs equal to 1 using the Tier 1 EPC and greater than 1 using the Tier 2 EPC. However, there is low confidence in the ESL because it is based on unspecified toxic effects. No additional ESL without high uncertainty was available for silver; therefore it is unclear whether there is potential for adverse effects using only the default ESL.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results for all receptors regardless of whether refined HQs were calculated to address uncertainties.

Silver – Risk Description

Silver was identified as an ECOPC for terrestrial plants only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

The LOEC HQ was equal to 1 using the Tier 1 UTL and greater than 1 using the Tier 2 UTL (HQ = 4). Therefore, the potential for adverse effects to populations of terrestrial plants is likely to be low to moderate. However, there is high uncertainty due to the lack of confidence in the toxicity information on the effects of silver on plants.

10.1.6 Tin

Tin HQs for the American kestrel, mourning dove (herbivore and insectivore), and deer mouse (insectivore) are presented in Table 10.1. Figure 10.6 shows the spatial distribution of tin in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #12, #17, and #18) are presented in Table 10.2.

For non-PMJM and PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Tin – Risk Description

Tin was identified as an ECOPC for the American kestrel, mourning dove (herbivore and insectivore), deer mouse (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were less than or equal to 1 for the mourning dove (herbivore) and American kestrel. NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore). All LOAEL HQs for all receptors were less than 1. Therefore, the potential for adverse effects to populations of small home-range receptors such as the mourning dove (herbivore and insectivore), American kestrel and deer mouse (insectivore) are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Tin samples were available from 28 grid cells (Figure 10.6). NOAEL HQs greater than 1 were calculated in 58 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to tin.

PMJM Receptor

Results of the PMJM risk calculations indicate that all NOAEL HQs were greater than 1 in Patches #12, #17, and #18 (Table 10.2). Tin was not detected in Patch #15 and was, therefore, not identified as an ECOPC for that patch. Figure 8.4 presents tin sampling locations and point-by-point comparisons to the PMJM ESL.

The highest NOAEL HQ was calculated in Patch #12 (HQ = 7), while Patch #17 and #18 had NOAEL HQs equal to 2. LOAEL HQs were less than 1 in all three patches, ranging from 0.1 to 0.03. Because no HQs greater than 1 were calculated using any effects-based TRV, the potential for adverse effects to PMJM receptors are likely to be low in all three patches.

10.1.7 Vanadium

Vanadium HQs for terrestrial plants and the deer mouse (herbivore and insectivore) are presented in Table 10.1. Figure 10.7 shows the spatial distribution of vanadium in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #12, #15, #17, and #18) are presented in Table 10.2.

For terrestrial plants, HQs calculated using the default ESL were greater than 1. An additional LOEC ESL was available for a refined analysis. Therefore, additional HQs were calculated.

For the deer mouse (herbivore and insectivore), LOAEL HQs were less than 1 using the default risk model and no additional HQs were calculated.

For PMJM receptors, no LOAEL HQs greater than 1 were calculated in any habitat patch using the default HQ calculations. Therefore, no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Vanadium – Risk Description

Vanadium was identified as an ECOPC for terrestrial plants, the deer mouse (herbivore and insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, HQs were greater than 1 using the default ESL. However, Efroymson et al. (1997a) places low confidence in the TRV because there are no primary reference data showing toxicity to plants and the ESL value is based on unspecified toxic effects.

The uncertainty assessment recommended the use of an alternative LOEC value (50 mg/kg). HQs based on this LOEC ESL were less than 1, indicating that the potential for adverse effects to terrestrial plant populations are likely to be low. However, there is low confidence in this alternative LOEC as well (see Attachment 5).

In addition, the default NOEC ESL (2 mg/kg) is less than all site-specific background concentrations. HQs greater than 1 were calculated using UTL and UCL background concentrations (HQ = 23 and 15, respectively). An HQ equal to 5 would be calculated using the minimum background concentration and the default ESL.

The potential for risk to terrestrial plant populations from exposure to vanadium in surface soils is likely to be low although there is high uncertainty or low confidence in both ESLs used in the risk calculations.

Non-PMJM Receptors – Small Home Range

Tier 1 EPCs resulted in NOAEL HQs less than 1 for the deer mouse (herbivore) and greater than 1 for the deer mouse (insectivore) (Table 10.1. NOAEL HQs were greater than 1 using the Tier 2 EPCs for both receptors.

LOAEL HQs were less than 1 for both receptors. Therefore, the potential for adverse effects to populations of the deer mouse (herbivore and insectivore) from exposure to vanadium are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Vanadium samples were available from 28 grid cells (Figure 10.7). NOAEL HQs greater than 1 were calculated in 64 percent of the grid cells while no grid cells had LOAEL HQ greater than 1 for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors result in low risk from exposure to vanadium.

PMJM Receptors

NOAEL HQs were greater than 1 (HQs = 2) in all four patches (#12, #15, #17, and #18) (Table 10.2). Figure 8.4 presents vanadium sampling locations and a comparison to the PMJM ESL.

LOAEL HQs were less than 1 in all four patches using the default risk model. The results indicate that the potential for adverse effects to PMJM receptors are likely to be low in all four patches.

10.1.8 Zinc

Zinc HQs for terrestrial plants, American kestrel, mourning dove (herbivore and insectivore), and deer mouse (insectivore) are presented in Table 10.1. Figure 10.8 shows the spatial distribution of zinc in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #12, #15, #17, and #18) are presented in Table 10.2.

For the terrestrial plant, HQs calculated using the default ESL were greater than 1 (HQs = 2). No additional ESL was available and no additional HQs were calculated.

For non-PMJM vertebrate receptors, no LOAEL HQs greater than 1 were calculated. using the default assumptions and no additional HQs were calculated.

For PMJM receptors, no LOAEL HQs greater than 1 were calculated using the default exposure assumptions and no alternative HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Zinc – Risk Description

Zinc was identified as an ECOPC for terrestrial plants, American kestrel, mourning dove (herbivore and insectivore), deer mouse (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

HQs were greater than 1 (HQs = 2) using the default risk model (Table 10.1). Because only the most conservative, non-spatially representative EPC had an HQ greater than 1 using the default ESL, the potential for adverse effects to terrestrial plant populations in the UWNEU from exposure to zinc in surface soils is likely to be low.

In addition, the results of the risk calculations are approximately equal to those calculated in background soils; therefore, risks to terrestrial plants from zinc in UWNEU surface soils are very similar to those in background areas.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were less than or equal to 1 for the mourning dove (herbivore) and American kestrel. NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore). LOAEL HQs were less than 1 for all four receptors. Because no HQs greater than 1 were calculated using effects-based TRVs, the potential for adverse effects to populations of small home range receptors such as the mourning dove (herbivore and insectivore), American kestrel, and deer mouse (insectivore) are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Zinc samples were available from 28 grid cells (Figure 10.8). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors are at low risk from exposure to zinc.

PMJM Receptor

Potential risks to PMJM were evaluated in Patches #12, #15, #17, and #18. Zinc sampling locations and comparisons to both background concentrations and the PMJM ESL are presented in Figure 8.6.

NOAEL HQs were greater than 1 in all four patches (HQs =2) (Table 10.2). However, LOAEL HQs were less than 1 in all four patches. Because LOAEL HQs were less than 1, the potential for adverse effects to PMJM receptors are likely to be low in all four patches.

10.1.9 Bis(2-ethylhexyl)phthalate

Bis(2-ehtylhexylphthalate) HQs for the American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.9 shows the spatial distribution of bis(2-ethlyhexyl)phthalate in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

No LOAEL HQs greater than 1 were calculated for any non-PMJM receptor and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Bis(2-ethylhexyl)phthalate – Risk Description

There is no identified source in the UWNEU of bis(2-ethylhexyl)phthalate, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs using default risk models were greater than 1 for both receptors (Table 10.1). LOAEL HQs were less than 1 for both receptors. Therefore, the potential for adverse effects to populations of small home range receptors such as the mourning dove (insectivore) and American kestrel are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Bis(2-ethylhexyl)phthalate samples were available from 17 grid cells (Figure 10.9). NOAEL HQs greater than 1 were calculated in 82 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to bis(2-ethylhexyl)phthalate.

10.1.10 Di-n-butylphthalate

Di-n-butylphthalate HQs for American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.10 shows the spatial distribution of di-n-butylphthalate in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

LOAEL HQ were less than 1 for the American kestrel. LOAEL HQs greater than 1 were calculated for the mourning dove (insectivore) receptor. However, as discussed in the uncertainty analysis, no median BAF or additional TRVs were available for a refined risk analysis.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Di-n-butylphthalate – Risk Description

There is no identified source of di-n-butylphthalate in the UWNEU, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and American kestrel (Table 10.1). LOAEL HQs were also greater than 1 for the mourning dove (insectivore) but were less than 1 for the American kestrel. Therefore, the potential for adverse effects to the American kestrel are likely to be low from exposure to di-n-butylphthalate. Risks to the mourning dove (insectivore) using the default HQ calculations may potentially be significant and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Di-n-butylphthalate samples were available from 17 grid cells (Figure 10.10). NOAEL and LOAEL HQs greater than 1 were calculated in 100 percent of the grid cells. All LOAEL HQs were between 1 and 5 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors requires further evaluation.

The uncertainty analysis discussed the low confidence in the BAFs used in the exposure model and specifically, the potential for overestimation of invertebrate tissue concentrations from soil. It is, therefore, likely that the potential for adverse effects are somewhat overestimated. The potential for adverse effects to populations of the mourning dove (insectivore) are likely to be low to moderate. However, there is no known source of di-n-butylphthalate at the UWNEU, the highest LOAEL HQ calculated equaled 3, and the possibility for overestimation of risk is high because of the uncertainties in the default risk model.

10.1.11 Total PCBs

HQs for total PCBs for the mourning dove (insectivore) are presented in Table 10.1. Figure 10.11 shows the spatial distribution of total PCBs in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

PCB (Total) – Risk Description

There is no identified source of PCBs in the UWNEU, which was identified as an ECOPC for the mourning dove (insectivore) receptor. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small home-range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) using the default risk model (Table 10.1). LOAEL HQs were also less than 1 using both Tier 1 and Tier 2 EPCs for the mourning dove (insectivore). Therefore, the potential for adverse effects to populations of small home range receptors such as the mourning dove (insectivore) are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Total PCB samples were available from 17 grid cells (Figure 10.11). NOAEL HQs greater than 1 were calculated in 59 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors indicate low risk from exposure to total PCBs.

10.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species was gathered (Ebasco 1992). The purpose of this long-term program was to monitor specific habitats to provide a sitewide database from which to monitor trends in the wildlife populations at RFETS. Although a comprehensive compilation of monitoring results has not been presented, the annual reports of the monitoring program provide localized information and insights on the general health of the RFETS ecosystem. Permanent transects through three basic habitats were run monthly for more than a decade (K-H 2002). Observations were recorded concerning the abundance, distribution, and diversity of wide-ranging wildlife species, including observations of migratory birds, raptors, coyotes, and deer. Small mammal monitoring occurred through several tasks in the monitoring program. The Ecological Monitoring Program (DOE 1995) established permanent transects for small mammal monitoring in three habitat types; xeric grasslands, mesic grasslands, and riparian habitats. PMJM studies established small mammal trapping in nearly all riparian habitats across the site (K-H 1998a, 1999a, 2000a, 2001a, 2002a).

Migratory birds were tracked during all seasons, but most notably during the breeding season. Over 8 years of bird survey data were collected on 18 permanent transects. Field observations were summarized into species richness and densities by habitat type. Habitats comprised the general categories of grasslands, woodlands, and wetlands. However, summaries in annual reports are grouped by habitat types across RFETS and not within EUs because EU boundaries were determined well after the monitoring program had begun. Additionally, wide-ranging animals may use habitat in several EUs and do not recognize EU boundaries.

Summarizing songbird surveys over the breeding season, diversity indices for RFETS for all habitats combined over 8 years of observations (1991 and 1993 to 1999) show a steady state in diversity of bird communities (K-H 2000). Among habitats, results were similar with the exception of an increasing trend in species richness and a decreasing trend in bird densities in woodland habitats. Woodland bird communities consistently show the highest diversity when compared with bird communities in wetlands and grasslands. The decreasing trend can be mostly attributed to transient species (i.e., those species not usually associated with woody cover) except for red-tailed hawk (*Buteo jamaicensis*) and American goldfinch (*Carduelis tristis*). The red-tailed hawk change in density can be attributed to a loss of nesting sites in Upper Woman Creek during the survey period. Goldfinch abundance can be heavily influenced by the availability of food sources.

A subgroup of migratory birds is the neotropical migrants, which show declining populations in North America (Audubon 2005; Nature Conservancy 2005). Most of this decline is thought to be due to conversion of forest land to agriculture in the tropics, and conversion to real estate development in North America. Grassland birds that are neotropical migrants are also in decline. However, over the last 5 years on RFETS, the declining trends have not been observed, and densities for this group show an increase.

Raptors, big game species, and carnivores were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provide species-specific sitewide counts. Raptors were noted on relative abundance surveys and nest sites were visited repeatedly during the nesting season to confirm nesting success. The three most common raptors at RFETS are red-tailed hawk, great horned owl (*Bubo virginianus*), and American kestrel (*Falco sparverius*) (K-H 2002). One Swainson's hawk nest was noted in North Walnut Creek near the A-1 Pond and one great horned owl nest was observed within South Walnut Creek (Ryon 2005). All nests typically fledged two young of each species, except kestrels, which usually fledged two to three young. Each species had a successful nesting season each year during the monitoring period from 1991 to 1999, with a single exception. This exception was the loss of the red-tailed hawk nest in Upper Woman Creek (K-H 1997a, 1998) due to weather. The continued presence of nesting raptors at RFETS (K-H 2002) including the UWNEU, indicate that habitat quality and protection from human disturbance have contributed to making RFETS a desirable location for raptors to reproduce. Adequate habitat provides essential seasonal requirements. RFETS is estimated to be at optimum population density for raptors given available habitat and the territorial nature of these species (K-H 2000).

Two deer species inhabit RFETS: mule deer (*Odocoileus hemionus*), and white-tailed deer (*Odocoileus virginianus*). No white-tailed deer were present at RFETS in 1991 when monitoring began (K-H 2002). In 2000 (K-H 2001) the population of white-tailed deer was estimated to be between 10 and 15 individuals. White-tailed deer frequent UWNEU, but spend the majority of their time in LWOEU. Mule deer frequent all parts of RFETS (14 mi^2) year-round. The RFETS population from winter counts is estimated at a mean 125 individuals (n = 7), with a density of 14 deer per square mile (K-H 2000, 2002). Winter mule deer counts have varied from 100 to 160 individuals over the monitoring period (1994 to 2000), with expected age/sex class distributions (K-H 2001). Within the UWNEU, mule deer frequent grassland hillsides during the fall and winter months. The constant presence of human activity associated with pond management likely limits deer use in UWNEU. The mule deer populations from RFETS have been increasing at a steady state with good age/sex distributions (K-H 2001) over time and similar densities when compared to other "open" populations that are not hunted. This provides a good indicator that habitat quality is high and that site activities have not affected deer populations. It is unlikely that deer populations are depressed or reproduction is affected by contaminants. A recent study on actinides in deer tissue found that plutonium levels were near or below detection limits (Todd and Sattelberg 2004). This provides further support that the deer population is healthy.

Coyotes (Canis latrans) are the top mammalian predator at RFETS. They prey upon mule deer fawns and other smaller prey species. The number of coyotes using the site has been estimated at 14 to 16 individuals (K-H 2002). Through surveys across the site, coyotes have been noted to have reproduction success with as many as six dens active in 1 year (Nelson 2003). Typically at RFETS, three to six coyote dens support an estimated 14 to 16 individuals at any given time (K-H 2001). No coyote dens have ever been found within the UWNEU, likely due to the large amount of human activities associated with pond management. Coyotes have exhibited a steady population over time, thereby indicating their prey species continue to be abundant and healthy.

Small mammal trapping has occurred over several years as a component of the ecological monitoring program during studies of the Preble's mouse. The UWNEU has been trapped over several years (Ebasco 1992, K-Hill 2000). The inlets of the A-series and B-series ponds support the PMJM (*Zapus hudsonius preblei*) that have been captured consistently since monitoring began. These populations and their habitat are healthy and have not declined during 8 years of monitoring. However, populations are habitat restricted and appear isolated from each other and from populations in Lower Walnut Creek. This is most likely due to movement barriers created by the terminal dams (A-4 and B-5). As many as seven other small mammal species have been captured in the EU and typical small mammal species are listed in the section on Flora and Fauna of UWNEU (Section 1.4). Additionally, less common riparian species include hispid pocket mouse (*Chaetodipus hispidus*) and Mexican woodrat (*Neotoma mexicana*). Both species are an indication of diverse and healthy small mammal communities and monitoring has revealed abundance and species diversity that would be expected in typical native ecosystems on the plains of Colorado (Fitzgerald et al 1994).

The high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS including wildlife using the UWNEU.

10.3 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. Chemical-specific uncertainties are presented in Attachment 5 of this document and were discussed in terms of their potential effects on the risk characterization in the risk description section for each ECOPC. The following general uncertainties associated with the ERAs for all the EUs may under- or overestimate risk to an unknown degree; a full discussion of these general uncertainties is provided in Volume 2 of Appendix A of the RI/FS Report:

- Uncertainties associated with data quality and adequacy;
- Uncertainties associated with the ECOPC identification process;
- Uncertainties associated with the selection of representative receptors;
- Uncertainties associated with exposure calculations;
- Uncertainties associated with the development of NOAEL ESLs;
- Uncertainties associated with the lack of toxicity data for ECOIs; and
- Uncertainties associated with eliminating ECOIs based on professional judgment.

The following sections are potential sources of general uncertainty that are specific to the UWNEU ERA.

10.3.1 Uncertainties Associated with Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the UWNEU, respectively. A more detailed discussion is presented in Appendix A, Volume 2, Attachments 2 and 3 of the RI/FS Report, and Attachment 2 of this volume. The data quality assessment indicates the data are of sufficient quality for use in the CRA. The adequacy of the UWNEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates the number of UWNEU surface soil samples for each analyte group meet the data adequacy guideline; however, except for PMJM patch #12, the number of surface soil samples for only a few analyte groups in the PMJM patches meet the data adequacy guideline. However, the data for radionuclides, VOCs, SVOCs, and PCBs for all patches in the UWNEU indicate that the ESLs are not exceeded. Therefore, radionuclides and organics are not likely to be of concern in surface soil for the PMJM habitat patches. Only patches #15 and #16 do not meet the data adequacy guideline for metals. However, the more remote location of these patches from the historical IHSSs in and near the Industrial Area suggests that the metals data for the other patches in the EU (e.g. #12, #17, and #18) are representative, if not biased high, for patches #15 and #16. Therefore, although available data for each patch has been used to conduct patch-specific risk characterizations, there is greater reliability in the risk characterizations for PMJM patches #12, #17, and #18 findings. With respect to surface water data adequacy, the number of UWNEU surface water samples for each analyte group meet the data adequacy guideline; however, there are no current data for PCBs. Although there are no current PCB data, the historical data indicate PCBs are not detected, and therefore, a temporal trend in concentrations is not expected. However, professional judgment suggests PCBs have the potential to be ECOPCs in the North and South Walnut Creek Aquatic Exposure Units surface water had detection limits been lower, and therefore, there is some uncertainty in the risk assessment process with respect to PCBs in surface water.

Data used in the CRA must have detection limits to allow meaningful comparison to ESLs. When these detection limits exceed the respective ESLs, this is a source of uncertainty in the risk assessment. There are 14 analytes in surface soil that have detection limits that exceed the lowest ESLs, but these higher detection limits contribute only minimal uncertainty to the overall risk assessment process because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWNEU surface soil even if detection limits had been lower.

10.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the Upper Walnut Drainage Exposure Unit

Several ECOIs detected in the UWNEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 7.1, 7.3, and 7.12 with a “UT” designation. Included as a subset of the ECOIs with a “UT” designation are the essential nutrients (calcium, iron, magnesium, potassium, and sodium). Although these nutrients may be potentially toxic to certain ecological receptors at high concentrations, the uncertainty associated with the toxicity of these nutrients is expected to be low. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high-quality toxicological information for a large proportion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

ESLs and/or TRVs were not available for several of the ECOPC/receptor pairs identified in Section 7.0. These include antimony (birds), molybdenum (invertebrates), silver (invertebrates, birds, and mammals), tin (invertebrates), vanadium (invertebrates), bis(2-ethylhexyl)phthalate (plants and invertebrates), di-n-butylphthalate (invertebrates), and PCB (total) (invertebrates). The risks to these ECOPC/receptor pairs are uncertain. However, because risks to all of the ECOPCs mentioned above are considered to be low for those receptors where toxicity information is available, this source of uncertainty is not expected to be significant.

10.3.3 Uncertainties Associated with Eliminating Ecological Contaminants of Interest Based on Professional Judgment

Several analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the UWNEU. The weight-of-evidence approach indicates that there is no identified source or pattern of release in the

UWNEU, and the slightly elevated values of the UWNEU data for these ECOIs are most likely due to natural variation. The professional judgment evaluation is unlikely to have significant effect on the overall risk calculations because the ECOIs eliminated from further consideration are found at concentrations in UWNEU that are at levels that are unlikely to result in risk concerns for ecological receptors and are well within regional background levels. In addition, these ECOIs are not related to site-activities in the UWNEU and have very low potential to be transported from historical sources to the UWNEU.

10.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the general sources of uncertainty discussed tend to either underestimate risk or overestimate risk, many result in an unknown effect on the potential risks. However, the CRA Methodology outlines a tiered process of risk evaluation that includes conservative assumptions for the ECOPC identification process and more realistic assumptions, as appropriate, for risk characterization.

11.0 SUMMARY AND CONCLUSIONS

A summary of the results of this CRA for human health and ecological receptors in the UWNEU is presented below.

11.1 Data Adequacy

The adequacy of the UWNEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates the total number of UWNEU surface soil and sediment samples for each analyte group meet the data adequacy guideline; however, for individual PMJM patches, the data adequacy guideline for number of surface soil samples for all analyte groups is met for only one patch (patch #12). Although there are data limitations for the UWNEU, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) indicate that the data for PMJM patch #12 should be representative of the other PMJM patches. With regard to surface water data, the number of UWNEU surface water samples for each analyte group meet the data adequacy guideline, although there is no current data for PCBs. Even though PCBs were not detected in surface water in the EU, there is some uncertainty in the risk assessment process because of the high detection limits associated with the PCBs. Overall, it is possible to render risk management decisions using the existing data. In addition, for analytes that are not detected or detected at a frequency less than 5 percent, there are several analytes in surface soil that have detection limits that exceed the lowest ESLs, but these higher detection limits contribute only minimal uncertainty to the overall risk assessment process because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWNEU surface soil even if detection limits had been lower.

11.2 Human Health

An HHRA was performed for the UWNEU for analytes identified as COCs. In the COC screening analyses, MDCs and UCLs of analytes in UWNEU media were compared to PRGs for the WRW receptor. Inorganic and radionuclide analytes with UCLs greater than the PRGs were statistically compared to the background concentration data set. Inorganic analytes that were statistically greater than background at the 0.1 significance level, and organics with UCL concentrations greater than the PRG were carried forward to professional judgment evaluation. Based on the COC selection process, benzo(a)pyrene was retained as a COC for surface soil/surface sediment. No COCs were identified for subsurface soil/subsurface sediment. The estimated Tier 1 total excess lifetime cancer risk for potential exposure of the WRW to surface soil/surface sediment at the UWNEU is 1E-06, and the Tier 2 risk is 1E-06. The estimated total Tier 1 cancer risk for potential exposure of the WRV to surface soil/surface sediment based on the Tier 1 EPC is 2E-06, and the Tier 2 risk is 1E-06.

Although selected as a COC for the HHRA, benzo(a)pyrene has not been directly associated with historical IHSSs, but could be associated with traffic, pavement degradation, or pavement operations within parts of the UWNEU or nearby IAEU. In addition, polynuclear aromatic hydrocarbons (PAHs) are ubiquitous in the environment and typical concentrations in urban soil range from 165 to 220 µg/kg (ATSDR 1995). Therefore, under similar exposure conditions as those evaluated for the UWNEU, background risks from benzo(a)pyrene in urban soils would be 30 to 40 percent of that estimated for the UWNEU, or approximately 3E-07 to 4E-07.

The risk characterization for exposure of the WRW and WRV to surface soil/surface sediment indicated that the estimated cancer risks for both receptor populations were at the lower end or below the 10^{-6} to 10^{-4} risk range. Noncancer risks were not estimated because noncancer toxicity criteria are not available for benzo(a)pyrene.

11.3 Ecological Risk

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ECOIs that are present in the UWNEU. The ECOPC identification process is described in the CRA Methodology (DOE 2005a) and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. Antimony, copper, molybdenum, nickel, silver, tin, vanadium, zinc, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total PCBs were identified as ECOPCs for representative populations of non-PMJM receptors in surface soil. ECOPCs for individual PMJM receptors included antimony, nickel, tin, vanadium, and zinc. Although there are no dioxin data for surface soil, the evaluation of site-wide data indicate dioxins are not expected to be present in UWNEU surface soil, however, there is some uncertainty in the overall risk estimates for the UWNEU as a result of this data limitation. No ECOPCs were identified in subsurface soil for burrowing receptors.

ECOPC/receptor pairs were evaluated in the risk characterization using conservative default exposure and risk assumptions as defined in the CRA Methodology. Tier 1 and Tier 2 EPCs were used in the risk characterization: Tier 1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. In addition, a refinement of the exposure and risk models based on chemical-specific uncertainties associated with the initial default exposure models were completed for several ECOPC/receptor pairs to provide a refined estimate of potential risk.

Using Tier 1 EPCs and default exposure and risk assumptions, NOAEL or in some cases LOEC HQs ranged from 47 (nickel/deer mouse-insectivore) to less than 1 (several ECOPC/receptor pairs). NOAEL or LOEC HQs also ranged from 129 (vanadium/terrestrial plants) to less than 1 (several ECOPC/receptor pairs) using Tier 2 EPCs and default exposure and risk assumptions (Table 10.1).

For terrestrial plants, antimony, silver, vanadium, and zinc all had HQs greater than or equal to 1 using Tier 1 and Tier 2 EPCs. However, there is low confidence placed in the ESLs for terrestrial plants for all four of these ECOPCs. As discussed in Attachment 5, additional NOEC or LOEC values for antimony, silver and zinc were either not acceptable for use in the CRA (low confidence in the additional values) or not available in the literature. For vanadium, an additional LOEC value was available for refined risk calculations.

For antimony, the LOEC HQ was greater than 1 for both the Tier 1 and Tier 2 UTL (HQs = 6 and 4 respectively). For silver, the LOEC HQ was equal to 1 using the Tier 1 UTL, but greater than 1 using the Tier 2 UTL (HQ = 4). For zinc, HQs were greater than 1 using both the Tier 1 and Tier 2 UTLs (HQs = 2). Therefore, risks to populations of terrestrial plants from exposure to antimony, silver, and zinc in surface soils are likely to be low to moderate but with a high level of uncertainty due to low confidence in the ESLs.

For vanadium, HQs based on the default ESL (2 mg/kg) were greater than 1 using both the Tier 1 and Tier 2 UTLs. The uncertainty assessment recommended using an additional LOEC value (50 mg/kg) in a refined risk calculation. HQs were less than 1 using the Tier 1 EPC and greater than 1 using the Tier 2 EPC in the refined analysis. The potential for risk to terrestrial plant populations in the UWNEU from exposure to vanadium in surface soils is likely to be low to moderate although there is high uncertainty or low confidence in both ESLs used in the risk calculations. In addition, the HQ based on the default ESL and the background UTL (HQ = 23) is similar to the HQ based on the default ESL and the UWOEU Tier 1 UTL (HQ = 25).

Most of the ECOPC/receptor pairs for birds and mammals had LOAEL HQs less than or equal to 1 using the default assumptions used in the risk calculations. However, the following ECOPC/receptor pairs had LOAEL HQs greater than 1 using the default exposure and toxicity assumptions:

- Antimony/deer mouse (insectivore) - – The LOAEL HQ was equal to 3 and 2 using the Tier 1 and Tier 2 EPCs in the default risk model, respectively. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. The potential for risks to populations of small mammals such as the deer mouse (insectivore) are likely to be low to moderate. However, there is considerable uncertainty or low confidence in the default risk model.

Antimony/PMJM – The LOAEL HQ was equal to 2 in Patch #18 using the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that the LOAEL HQ is only equal to 2, risks to PMJM receptors within Patch #18 are likely to be low but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWNEU are likely to be low. However, there is considerable uncertainty or low confidence in the default risk model.

Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 5 and 4 using the Tier 1 and Tier 2 EPCs, respectively. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, no LOAEL HQs greater than 1 were calculated. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). No HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV in the refined analysis. Based on these additional risk calculations using the median BAF or the additional NOAEL or LOAEL TRVs, risks to populations of small mammals such as the deer mouse (insectivore) receptor are likely to be low.

Nickel/PMJM - LOAEL HQs were greater than 1 (HQs = 2) in Patches #12, #15, #17, and #18 using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, LOAEL HQs were less than 1 in all four patches. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the calculations in all four patches. Based on the additional risk calculations using either the median BAF or the additional TRVs in the refined analysis, risks to the PMJM receptor from exposure to nickel are likely to be low.

Di-n-butylphthalate/mourning dove (insectivore) – LOAEL HQs were equal to 2 using the Tier 1 EPC and equal to 3 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small birds such as the mourning dove (insectivore) receptor are likely to be low to moderate although there is considerable uncertainty or low confidence in the default risk model. In addition, there is no known source of di-n-butylphthalate at UWNEU.

Based on default and refined calculations, site-related risks are likely to be low to moderate with some high levels of uncertainty for the ecological receptors evaluated in the UWNEU (Table 11.1). In addition, data collected on wildlife abundance and diversity indicate that wildlife species richness remains high at RFETS. There are no significant risks to ecological receptors or high levels of uncertainty with the data, and therefore, there are no ecological contaminants of concern (ECOCs) for the UWNEU.

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TABLES

Table 1.1
UWNEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
101	IA	000-101	207 Solar Evaporation Ponds	The Solar Ponds were constructed primarily to store and treat by evaporation low-level radioactive process wastes containing high nitrates, and neutralized acidic wastes containing aluminum hydroxide. During remediation, some components were removed; however, pond liners, below-grade drainage tiles and sumps, and leak detection systems (lines and sumps) were left in place. Prior to the berms being pushed in, the liners were perforated to prevent water from accumulating in the area above the liners and to allow water to percolate down. After the berms were pushed in, the area was graded and vegetated.	NFAA -2005 HRR
141	BZ	900-141	Sludge Dispersal	Prior to 1985, the Sludge Dispersal Area received airborne radioactive particles from dried sewage treatment sludge packaging operations.	NFAA -2005 HRR
142.1	BZ	NE-142.1	Pond A-1	Pond A-1 is the westernmost retention pond in North Walnut Creek and has a capacity of 1,660,000 gallons. Pond A-1 and Pond A-2 were used for spill control and held radionuclide contaminated laundry wastewater, process liquid waste, cooling tower blowdown, and steam condensate drainage.	NFAA - 2005 HRR
142.2	BZ	NE-142.2	Pond A-2	Pond A-2 has a capacity of 6,700,000 gallons, and was linked in series with Pond A-1. The two ponds were both used for spill control and held radionuclide-contaminated laundry wastewater, process liquid waste, cooling tower blowdown, and steam condensate discharges.	NFAA - 2005 HRR
142.3	BZ	NE-142.3	Pond A-3	Pond A-3 was constructed in 1974, had a capacity of 14,110,000 gallons, and received surface water from North Walnut Creek and runoff from the northern production facilities via the A-1 Bypass.	NFAA - 2005 HRR
142.4	BZ	NE-142.4	Pond A-4	Pond A-4 was constructed in 1980 to impound water from upstream and to retain water for monitoring prior to scheduled discharges. Water from Pond A-4 was discharged to Walnut Creek.	NFAA - 2005 HRR
142.5	BZ	NE-142.5	Pond B-1	Pond B-1 is a 795,000-gallon retention pond used primarily for spill control management and detention of surface runoff from the Industrial Area. The water collected was disposed of via spray evaporation. The pond was remediated (sediment removal) in 2005.	NFAA - 2005 HRR
142.6	BZ	NE-142.6	Pond B-2	Pond B-2, the second retention pond along South Walnut Creek, has a capacity of 1,930,000 gallons. Pond B-2 was primarily used for spill control management and detention of surface runoff from the Industrial Area. The water collected was disposed of via spray evaporation. The pond was remediated (sediment removal) in 2005.[a]	NFAA - 2005 HRR

Table 1.1
UWNEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
142.7	BZ	NE-142.7	Pond B-3	Pond B-3, the third retention pond along South Walnut Creek, had a capacity of 600,000 gallons. Pond B-3 received effluent from the Sewage Treatment Plant and local runoff. Water in Pond B-3 was continuously discharged to Pond B-4. The pond was remediated (sediment removal) in 2005.	NFAA - 2005 HRR
142.8	BZ	NE-142.8	Pond B-4	Pond B-4, the fourth pond along South Walnut Creek, has a capacity of 23,140,000 gallons. Water in Pond B-3 was continuously discharged to Pond B-4 under an NPDES agreement. Water in Pond B-4 was continuously discharged to Pond B-5. The water in Pond B-4 was sampled and analyzed routinely.	NFAA - 2005 HRR
142.9	BZ	NE-142.9	Pond B-5	Pond B-5 was the farthest downstream of the B-series ponds along South Walnut Creek, and received continuous discharge from Pond B-4. Pond B-5 also received surface runoff from the Central Avenue Ditch. The water in Pond B-5 was not discharged to South Walnut Creek but was periodically pumped to Pond A-4, where the water was monitored prior to discharge to Walnut Creek.	NFAA - 2005 HRR
156.2	BZ	NE-156.2	Soil Dump Area Between the A and B Series Drainages	IHSS 156.2 is located east of the Industrial Area between North and South Walnut Creeks. The 255,000 square-foot area received between 50 and 75 dump truck loads of soil excavated during construction projects, as well as asphalt debris and concrete.	NFAA -2005 HRR
170	BZ	NW-170	PU&D Storage Yard - Waste Spills	Beginning in 1974, the P.U.& D. Storage Yard stored barrels, drums, and cargo boxes, spent batteries, empty dumpsters, dumpsters filled with metal shavings coated with lathe coolant, and drums of spent solvents and waste oils.	NFAA -2005 HRR
190	IA	000-190	Caustic Leak (also referred to as Central Avenue Ditch)	The Caustic Leak occurred in 1978 when approximately 1,000 gallons of concentrated sodium hydroxide were accidentally released from the steam plant catch basin to the Central Avenue ditch. The liquid was diverted to Pond B-1, neutralized with alum, and subsequently evaporated.	NFAA -2005 HRR
216.1	BZ	NE-216.1	East Spray Fields - North Area	This area was used briefly for spray evaporation of sewage treatment plant effluent and runoff detained in Pond B-3.	NFAA -2005 HRR
	BZ	000-501	Roadway Spraying	Roadways in the BZ OU were occasionally sprayed with waste oils for dust suppression, but sometimes reverse osmosis brine solutions and footing drain water were also applied. [b]	NFAA -2005 HRR

Table 1.1
UWNEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
	BZ	900-1309	OU 2 Field Treatability Unit Spill	On December 4, 1993, approximately 10 gallons of influent water from the OU2 treatment system were released to the environment. The water was assumed to contain F001-coded RCRA waste (chlorinated solvents) because recent system analytical data indicated that chlorinated solvents were present above applicable standards.	NFAA -2005 HRR
	BZ	NE-1404	Diesel Spill at Pond B-2 Spillway	A release of approximately 18 gallons of diesel fuel resulted from a leak in the fuel tank of a portable pump used to transfer water from Pond B-2 to Pond A-2.	NFAA -2005 HRR
	BZ	NE-1405	Diesel Fuel Spill at Field Treatability Unit	Approximately 20 gallons of diesel fuel were released to the environment due to overfilling of a diesel fuel tank which supplied a portable generator for the OU2 Treatment Facility.	NFAA -2005 HRR
	BZ	NE-1406	771 Hillside Sludge Release	During excavation activities for construction on the 771 hillside, an odoriferous and dark colored soil was identified. This soil appeared to be sanitary wastewater treatment plant sludge. Based on the lack of evidence for contamination, NFA status was conferred for PAC NE-1406 on July 9, 1999.	NFAA -2005 HRR
	BZ	NE-1407	OU 2 Treatment Facility	On March 9, 1993, approximately 50 gallons of untreated seepage/spring water leaked from secondary containment at the OU2 Treatment Facility. Routine sampling of the influent indicated concentrations of carbon tetrachloride, trichloroethane, PCE, chromium, and 1,2 DCE were present slightly above the SWDA drinking water standards.	NFAA -2005 HRR
	BZ	NE-1408	OU 2 Test Well	Approximately 10 gallons of groundwater containing F001-coded RCRA waste (chlorinated solvent) was spilled when a casing being installed for a new bedrock monitoring well displaced groundwater from the borehole onto the ground.	NFAA -2005 HRR
	BZ	NE-1409	Modular Tanks and 910 Treatment System Spill	On July 20, 1993, approximately 4,700 gallons of RCRA F-listed water began leaking from the primary containment piping that connected the Modular Storage Tanks to the Solar Evaporation Ponds Interceptor Trench System sump into the secondary containment.	NFAA -2005 HRR
	BZ	NE-1410	Diesel Fuel Spill at Field Treatability Unit	Two spills of diesel fuel occurred during refueling of an emergency generator unit with diesel fuel at OU 2. The largest spill was 2 – 3 gallons of fuel.	NFAA -2005 HRR
	BZ	NE-1411	Diesel Fuel Overflowed from Tanker at OU 2 Field Treatability Unit	As garage employees were refueling a diesel generator located near OU 2, approximately 20 gallons of diesel fuel was released to the ground.	NFAA -2005 HRR

[a] Regulatory agency approval pending on Draft Closeout Report for IHSS Group NE-1, B-Ponds (B-1, B-2, and B-3), May 2005.

[b] PAC 000-501 was one of 79 IHSSs/PACs proposed for NFA by the NFA Working Group in 1991. The NFA was approved in 2002 (EPA et al. 2002).

Table 1.2
Number of Samples in Each Medium by Analyte Suite

Analyte Suite	Surface Soil/Surface Sediment[a]	Subsurface Soil/Subsurface Sediment[a]	Surface Soil[b]	Surface Soil within PMJM Habitat[b]	Subsurface Soil[b]
Inorganics	152	160	90	62	96
Organics	135	194	53	54	138
Radionuclides	199	174	117	75	111

[a] Used in the HHRA.

[b] Used in the ERA.

Note: The total number of results (samples) in Tables 1.3 through 1.7 may differ from the total number of samples presented in Table 1.2 because not all analyses are necessarily performed for each sample.

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		151	100	1,700	29,000	12,856	5,456
Antimony	0.29 - 37.4	141	30.5	0.460	43.6	8.39	9.16
Arsenic		151	100	1.10	11	5.36	1.90
Barium		151	100	24.9	272	147	48.0
Beryllium	0.19 - 1.9	151	56.3	0.260	1.50	0.732	0.359
Boron		36	100	1.20	30	7.59	5.06
Cadmium	0.046 - 3.3	151	41.1	0.0360	3.10	0.633	0.454
Calcium		151	100	692	92,000	13,672	12,232
Cesium	1.6 - 587	104	55.8	0.980	7.30	21.9	39.1
Chloride		3	100	48.9	83.8	61.1	19.7
Chromium	1.3 - 20	151	90.7	2.20	66.5	13.5	7.35
Chromium (VI)	0.005 - 1	4	25	0.00700	0.00700	0.128	0.248
Cobalt	7.8 - 9.7	151	98.7	1.90	20.1	8.37	2.72
Copper	12.7 - 12.7	151	99.3	4.50	61.6	18.8	7.84
Fluoride		3	100	2.76	4.55	3.52	0.924
Iron		151	100	5,060	37,100	16,275	5,093
Lead		151	100	5.80	234	24.8	19.8
Lithium	4.4 - 18.1	147	74.1	1.80	24	8.95	4.52
Magnesium		151	100	665	12,200	3,537	1,767
Manganese		151	100	94.4	1,760	308	201
Mercury	0.017 - 0.18	147	40.1	0.00620	0.220	0.0508	0.0393
Molybdenum	0.13 - 13	148	27.0	0.160	19.1	1.85	1.78
Nickel	6.4 - 26.4	151	97.4	3.20	31.6	14.8	4.78
Nitrate / Nitrite	0.2 - 2.5	64	71.9	0.288	19	2.35	3.45
Potassium	1,150 - 2,180	151	97.4	402	4,430	2,142	767
Selenium	0.22 - 4.6	151	20.5	0.270	2.40	0.443	0.432
Silica[c]		36	100	259	3,300	1,005	541
Silicon[c]		28	100	64.9	4,570	1,630	1,415
Silver	0.058 - 6.3	146	21.2	0.0980	8.90	0.919	1.04
Sodium	59.2 - 290	151	72.2	41.7	2,100	297	314
Strontium		148	100	5.50	255	62.4	34.0
Thallium	0.2 - 3.5	148	25	0.230	1.20	0.324	0.251
Tin	0.74 - 61.9	146	12.3	1.20	39.5	7.93	7.05
Titanium		36	100	36	844	171	165

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Uranium	1.4 - 39	43	2.33	4.30	4.30	4.02	3.51
Vanadium		151	100	6.70	75.9	35.5	11.8
Zinc		151	100	20.8	540	92.8	83.0
Organics (ug/kg)							
1234678-HpCDF		1	100	0.00251	0.00251	0.00251	0
123478-HxCDF		1	100	5.66E-04	5.66E-04	5.66E-04	0
123678-HxCDD		1	100	0.00122	0.00122	0.00122	0
123789-HxCDD		1	100	0.00106	0.00106	0.00106	0
2-Butanone	4.19 - 1,300	38	13.2	3	43	42.6	145
2-Methylnaphthalene	350 - 3,600	66	1.52	120	120	376	336
4,4'-DDE	5.4 - 120	75	1.33	4.10	4.10	11.1	6.53
4,4'-DDT	5.4 - 120	75	4	2.90	4.90	10.7	6.59
Acenaphthene	350 - 1,800	66	12.1	59	620	280	156
Acetone	3.53 - 1,300	36	19.4	16	230	67.1	150
Aldrin	2.7 - 60	74	1.35	54	54	6.26	6.50
Anthracene	350 - 1,800	66	16.7	48	970	279	176
Aroclor-1254	1.83 - 1,300	123	17.1	28	590	113	81.1
Aroclor-1260	370 - 3,600	120	4.17	42	160	113	71.1
Benzene	350 - 3,600	38	2.63	3	3	21.2	105
Benzo(a)anthracene	350 - 3,600	66	40.9	38	1,400	320	377
Benzo(a)pyrene	350 - 3,600	66	31.8	48	1,300	345	366
Benzo(b)fluoranthene	350 - 3,600	66	42.4	43	1,500	334	380
Benzo(g,h,i)perylene	1,700 - 18,000	66	22.7	58	480	330	342
Benzo(k)fluoranthene	350 - 3,600	66	34.8	50	1,100	343	363
Benzoic Acid	350 - 3,600	60	10	180	220	1,836	1,822
bis(2-ethylhexyl)phthalate	690 - 690	66	48.5	44	3,600	394	510
Butylbenzylphthalate	1.83 - 22	66	3.03	140	220	377	336
Carbazole	370 - 3,600	3	66.7	30	56	144	175
Carbon Tetrachloride	2.7 - 60	39	5.13	390	440	25.3	92.0
Chrysene	350 - 3,600	66	40.9	42	1,500	330	378
delta-BHC	350 - 3,600	75	1.33	13	13	5.70	3.34
Dibenz(a,h)anthracene	5.4 - 120	66	3.03	65	92	360	335
Dibenzofuran	350 - 3,600	66	3.03	100	300	377	336
Dieldrin	350 - 3,600	75	1.33	4.60	4.60	11.1	6.53
Di-n-butylphthalate	2.7 - 24	66	12.1	41	190	354	347

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Di-n-octylphthalate	400 - 3,600	66	1.52	570	570	383	335
Endosulfan I	350 - 3,600	75	1.33	20	20	5.47	2.28
Fluoranthene		66	56.1	40	3,100	411	522
Fluorene	350 - 3,600	66	9.09	59	650	365	340
Heptachlorodibenzo-p-dioxin	27 - 600	1	100	0.0199	0.0199	0.0199	0
Indeno(1,2,3-cd)pyrene	1.78 - 48	66	27.3	43	490	320	347
Methoxychlor	1.87 - 3,600	75	1.33	2.70	2.70	55.5	32.9
Methylene Chloride		36	25	7	420	33.3	94.2
Naphthalene		76	2.63	110	290	303	317
OCDD	35 - 1,200	1	100	0.161	0.161	0.161	0
OCDF	35 - 1,200	1	100	0.00883	0.00883	0.00883	0
Phenanthrene	350 - 3,600	66	40.9	55	3,300	395	520
Pyrene	370 - 3,600	66	40.9	49	3,900	448	586
Tetrachloroethene	1.84 - 1,300	39	10.3	2	4	37.6	144
Toluene	1.85 - 1,300	38	21.1	3	130	26.3	106
Trichloroethene	1.45 - 1,300	38	10.5	2	2	21.4	105
Trichlorofluoromethane	3.41 - 22	15	13.3	2	4	3.14	2.30
Radionuclides (pCi/g)[d]							
Americium-241		171	N/A	-0.0314	6.89	0.405	0.805
Cesium-134		43	N/A	-0.201	0.200	0.0226	0.0814
Cesium-137		62	N/A	0.00300	0.680	0.227	0.186
Gross Alpha		95	N/A	-6.20	39.6	18.2	7.96
Gross Beta		115	N/A	8.08	71.7	27.6	7.94
Plutonium-239/240		188	N/A	-0.0460	22.4	1.22	2.42
Radium-226		29	N/A	-0.340	3.08	1.36	0.803
Radium-228		46	N/A	0.0400	2.40	1.54	0.359
Strontium-89/90		56	N/A	0.0118	1.80	0.349	0.385
Uranium-233/234		153	N/A	0.435	3.70	1.20	0.590
Uranium-235		153	N/A	-0.0523	0.285	0.0671	0.0587
Uranium-238		153	N/A	0.360	6.10	1.42	1.04

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		158	100	1,290	49,000	11,711	7,355
Antimony	0.32 - 30.3	137	12.4	0.440	30.4	6.43	6.46
Arsenic	3.5 - 3.5	158	99.4	1.10	15.1	5.22	2.40
Barium		158	100	22.9	783	148	78.4
Beryllium	0.18 - 1.6	158	66.5	0.200	2.50	0.783	0.433
Boron	0.37 - 0.39	39	94.9	1.30	26	7.21	4.53
Cadmium	0.043 - 2.1	158	32.3	0.0500	44	0.988	3.54
Calcium		158	100	1,180	203,000	23,321	31,316
Cesium	0.69 - 134	114	33.3	0.710	6.80	11.0	18.8
Chromium	1.2 - 14	158	98.1	1.30	140	13.4	12.7
Cobalt	2.2 - 2.2	158	99.4	0.780	55	8.32	5.13
Copper	4.9 - 12.8	158	98.7	3.10	120	16.9	12.0
Iron		158	100	3,340	110,000	15,879	11,847
Lead		158	100	2	110	19.8	15.4
Lithium	0.76 - 23.6	146	65.1	2.20	37	9.08	6.95
Magnesium		158	100	595	11,000	3,113	1,286
Manganese		158	100	17.9	1,400	251	190
Mercury	0.0057 - 0.13	153	41.8	0.0130	1.70	0.0776	0.151
Molybdenum	0.1 - 9.7	158	27.8	0.250	6.30	2.05	1.19
Nickel	4.2 - 19.7	158	84.8	5.20	190	16.0	15.9
Nitrate / Nitrite	0.267 - 1.1	34	58.8	0.700	52.9	3.94	9.83
Potassium	561 - 1,260	158	88.6	410	6,500	1,573	969
Selenium	0.14 - 2.9	146	14.4	0.280	5.80	0.445	0.604
Silica		39	100	347	4,900	1,167	752
Silicon[c]		11	100	269	3,590	1,491	1,072
Silver	0.05 - 3.3	157	17.2	0.0770	3,100	21.5	247
Sodium	67 - 251	158	84.8	52.2	1,500	245	209
Strontium		158	100	12.2	506	76.0	53.3
Sulfide	12 - 14.1	11	9.09	37	37	9.09	9.26
Thallium	0.21 - 1.7	155	14.2	0.230	0.720	0.243	0.160
Tin	0.53 - 46.3	158	10.1	1.20	52.2	9.12	8.41
Titanium		39	100	20	310	115	67.0
Uranium	0.99 - 20	43	9.30	2.80	20	4.26	4.01
Vanadium		158	100	6.50	96	31.9	13.9
Zinc		158	100	10.8	706	81.2	81.2
Organics (ug/kg)							
1,1,1-Trichloroethane	1.092 - 1,600	173	0.578	6	6	23.6	92.5
1,1-Dichloroethene	1.538 - 1,600	176	0.568	3	3	23.3	91.7
1,2,3-Trichlorobenzene[c]	1.689 - 23	25	4	1.20	1.20	3.32	2.04
1,2,4-Trichlorobenzene	1.703 - 2,800	74	1.35	1	1	230	236
1,2,4-Trimethylbenzene	0.72 - 23	25	4	0.190	0.190	3.26	2.12
1,2-Dichloroethene	5 - 1,600	151	1.99	2	11	26.6	98.7

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
1234678-HpCDF	0.00135 - 0.00419	8	50	1.39E-04	0.0298	0.00470	0.0102
1234789-HpCDF	0.00135 - 0.00138	8	62.5	1.82E-04	0.00243	8.15E-04	6.86E-04
123478-HxCDD	0.00135 - 0.00474	8	12.5	0.00126	0.00126	0.00116	6.91E-04
123478-HxCDF	0.00135 - 0.00419	8	37.5	2.56E-04	0.00371	0.00119	0.00116
123678-HxCDD	0.00135 - 0.00474	8	12.5	0.00455	0.00455	0.00158	0.00139
123678-HxCDF	0.00135 - 0.00474	8	12.5	0.00250	0.00250	0.00132	8.39E-04
123789-HxCDD	0.00135 - 0.00474	8	12.5	0.00329	0.00329	0.00142	0.00102
123789-HxCDF	0.00135 - 0.00474	8	12.5	5.53E-04	5.53E-04	9.29E-04	5.93E-04
12378-PeCDF	0.00135 - 0.00474	8	12.5	0.00197	0.00197	0.00125	7.49E-04
234678-HxCDF	0.00135 - 0.00474	8	12.5	0.00199	0.00199	0.00126	7.51E-04
23478-PeCDF	0.00135 - 0.00474	8	12.5	0.00429	0.00429	0.00154	0.00131
2378-TCDD	5.4E-04 - 0.0019	8	25	2.26E-04	0.00278	7.44E-04	8.70E-04
2378-TCDF[c]	5.4E-04 - 0.0019	8	12.5	0.00612	0.00612	0.00117	0.00202
2-Butanone	6 - 3,100	161	32.3	2	3,700	169	502
2-Hexanone	6 - 3,100	169	0.592	0.820	0.820	48.8	185
4-Methyl-2-pentanone	6 - 3,100	168	2.38	5	21	49.2	185
Acenaphthene	360 - 1,500	62	1.61	89	89	270	108
Acetone	10 - 3,300	171	21.1	3	5,100	163	640
Anthracene	360 - 1,500	62	21.0	52	420	232	118
Aroclor-1254	50 - 50	65	30.8	34	5,200	293	742
Aroclor-1260	380 - 3,000	65	1.54	150	150	95.6	58.4
Atrazine	380 - 3,000	2	50	120	120	72.5	67.2
Benzo(a)anthracene	380 - 3,000	62	33.9	78	430	328	209
Benzo(a)pyrene	380 - 3,000	62	43.5	79	570	337	208
Benzo(b)fluoranthene	380 - 3,000	62	40.3	140	1,500	437	283
Benzo(g,h,i)perylene	1,800 - 14,000	62	19.4	95	320	342	248
Benzo(k)fluoranthene	380 - 2,800	62	27.4	74	540	361	262
Benzoic Acid	380 - 3,000	61	9.84	95	2,700	1,720	1,136
bis(2-ethylhexyl)phthalate	3.058 - 1,600	62	53.2	43	47,000	2,131	6,771
Butylbenzylphthalate	1.074 - 1,600	62	4.84	66	120	378	257
Carbon Disulfide	1.484 - 1,600	176	1.70	0.370	7.20	23.3	91.7
Carbon Tetrachloride	1.059 - 1,600	172	1.74	0.330	110	24.3	93.0
Chlorobenzene	380 - 3,000	176	0.568	74	74	23.7	91.8
Chloroform	2.6 - 12	177	10.2	0.250	84	24.3	91.5
Chrysene	380 - 3,000	62	50	73	650	344	222
cis-1,2-Dichloroethene	390 - 3,000	25	4	48	48	3.91	9.25
Dibenz(a,h)anthracene	380 - 3,000	62	1.61	110	110	378	252
Di-n-butylphthalate	380 - 3,000	61	8.20	46	75	374	264
Di-n-octylphthalate	9.2 - 23	62	9.68	66	250	369	261
Fluoranthene	0.00135 - 0.00419	62	53.2	45	1,400	523	359
gamma-BHC (Lindane)[c]	380 - 3,000	40	2.50	25	25	7.09	3.34
Heptachlorodibenzo-p-dioxin	5 - 8,300	8	50	7.08E-04	0.0946	0.0151	0.0328
Indeno(1,2,3-cd)pyrene	1.593 - 2,800	62	22.6	66	300	332	251

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Methylene Chloride	1.148 - 23	177	22.0	0.940	190	97.8	449
Naphthalene	0.00275 - 0.00276	74	2.70	1	1.50	230	236
n-Butylbenzene[c]	0.0027 - 0.00838	25	4	0.270	0.270	3.27	2.10
OCDD	36 - 420	8	75	5.18E-04	0.539	0.0858	0.187
OCDF	36 - 520	8	37.5	6.50E-04	0.0409	0.00717	0.0137
Phenanthrene	380 - 3,000	62	46.8	99	760	375	222
Phenol	380 - 3,000	61	1.64	54	54	378	256
Pyrene	380 - 3,000	62	50	71	1,200	472	310
Tetrachloroethene	1.751 - 1,600	176	10.2	1.40	56	23.7	91.7
Toluene	5 - 740	177	57.6	0.260	860	71.9	134
trans-1,2-Dichloroethene	2.6 - 12	25	4	2	2	2.07	1.08
Trichloroethene	5 - 1,600	177	18.6	0.540	3,500	59.8	284
Trichlorofluoromethane	1.522 - 23	25	8	2	2	3.32	2.03
Vinyl Chloride	5.1 - 3,100	176	0.568	16.8	16.8	45.9	182
Xylene	3.045 - 1,600	177	1.13	4	8	23.2	91.5
Radionuclides (pCi/g)[d]							
Americium-241		157	N/A	-0.0371	56.5	1.32	5.14
Cesium-134		16	N/A	-0.0918	0.0820	0.00944	0.0615
Cesium-137		44	N/A	-0.0433	0.832	0.210	0.193
Gross Alpha		107	N/A	5.20	70.7	17.9	12.1
Gross Beta		111	N/A	11	38	23.6	5.34
Plutonium-238		9	N/A	-0.00100	0.00500	0.00222	0.00228
Plutonium-239/240		153	N/A	-0.00879	217	3.96	18.7
Radium-226		12	N/A	0.377	2.96	1.19	0.805
Radium-228		14	N/A	1.28	1.87	1.57	0.187
Strontium-89/90		28	N/A	-6.58E-04	1.12	0.240	0.256
Uranium-233/234		169	N/A	0.0210	6.04	1.16	0.704
Uranium-235		169	N/A	-0.0166	0.352	0.0671	0.0682
Uranium-238		169	N/A	0	8.51	1.22	0.898

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		90	100	5,020	24,100	12,192	4,122
Antimony	0.29 - 15.2	84	44.0	0.460	43.6	10.8	9.79
Arsenic		90	100	1.80	9.60	4.96	1.74
Barium		90	100	40.4	272	148	48.3
Beryllium	0.19 - 1.4	90	54.4	0.310	1.50	0.708	0.369
Boron		13	100	1.20	10.4	4.74	2.44
Cadmium	0.046 - 1.7	90	34.4	0.100	2.70	0.595	0.414
Calcium		90	100	692	92,000	13,268	13,174
Cesium	6.5 - 145	68	75	0.980	7.30	16.1	26.0
Chromium	7.5 - 19.8	90	86.7	5	31.1	12.3	4.89
Cobalt	7.8 - 9.7	90	97.8	1.90	18.8	8.41	2.75
Copper	12.7 - 12.7	90	98.9	4.50	61.6	18.8	9.00
Iron	-	90	100	5,060	34,600	15,476	4,834
Lead	-	90	100	8.20	62	24.5	11.5
Lithium	4.8 - 18.1	86	74.4	3.60	14.2	8.06	2.98
Magnesium		90	100	665	12,200	3,578	2,081
Manganese		90	100	94.4	823	258	119
Mercury	0.017 - 0.12	86	37.2	0.00620	0.210	0.0435	0.0404
Molybdenum	0.13 - 5.8	87	17.2	0.160	19.1	1.92	2.02
Nickel	6.4 - 8.3	90	97.8	4.20	28.3	13.8	4.08
Nitrate / Nitrite	0.2 - 0.2	35	94.3	0.324	6.40	1.91	1.71
Potassium		90	100	988	4,430	2,202	636
Selenium	0.23 - 1.1	90	16.7	0.270	0.790	0.296	0.134
Silica[c]		13	100	409	930	707	170
Silicon[c]		14	100	1,190	4,570	2,754	1,152
Silver	0.058 - 2.9	88	20.5	0.180	8.90	0.899	1.13
Sodium	59.2 - 290	90	58.9	41.7	1,650	232	278
Strontium		87	100	8.70	255	56.1	30.4
Thallium	0.2 - 1.1	88	35.2	0.230	1.20	0.279	0.202
Tin	1 - 28.4	87	6.90	18.6	33.8	8.69	6.54
Titanium		13	100	37	844	248	256
Vanadium		90	100	14.1	75.9	35.7	11.3
Zinc		90	100	20.8	120	60.2	14.9
Organics (ug/kg)							
Acetone	3.53 - 160	13	23.1	23	61	19.0	27.8
Aroclor-1254	370 - 480	44	9.09	28	110	86.5	20.0
Aroclor-1260	370 - 480	44	9.09	42	160	88.7	20.9
Benzo(a)anthracene	370 - 480	17	17.6	38	46	185	70.2
Benzo(a)pyrene	370 - 480	17	17.6	48	63	187	65.8
Benzo(b)fluoranthene	370 - 480	17	41.2	43	94	154	77.4

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzo(g,h,i)perylene	1,800 - 2,400	17	5.88	58	58	206	41.2
Benzo(k)fluoranthene	400 - 480	17	41.2	50	110	159	71.3
Benzoic Acid	370 - 480	17	17.6	180	200	934	361
bis(2-ethylhexyl)phthalate	370 - 480	17	41.2	44	3,600	421	853
Butylbenzylphthalate	370 - 480	17	11.8	140	220	211	24.1
Chrysene	370 - 480	17	17.6	42	61	186	67.4
Di-n-butylphthalate	400 - 480	17	11.8	50	79	198	52.8
Di-n-octylphthalate	370 - 480	17	5.88	570	570	236	87.5
Fluoranthene	1.78 - 13	17	47.1	40	110	148	79.6
Indeno(1,2,3-cd)pyrene	38 - 230	17	17.6	43	61	186	65.5
Methylene Chloride	38 - 230	12	50	7	34	10.5	11.7
Phenanthrene	370 - 480	17	17.6	55	73	189	61.5
Pyrene	370 - 480	17	35.3	49	93	162	73.6
Tetrachloroethene	1.84 - 13	14	28.6	2	4	3.07	1.20
Toluene	1.85 - 6	14	7.14	130	130	11.3	34.2
Trichloroethene	1.45 - 13	14	28.6	2	2	2.77	1.27
Trichlorofluoromethane	3.41 - 6	13	15.4	2	4	2.51	0.764
Radionuclides (pCi/g)[d]							
Americium-241		97	N/A	-0.0314	4.48	0.283	0.644
Cesium-134		16	N/A	-0.0847	0.120	0.0189	0.0553
Cesium-137		16	N/A	0.00300	0.680	0.260	0.188
Gross Alpha		52	N/A	5	36	17.1	5.98
Gross Beta		68	N/A	17.3	71.7	28.6	8.69
Plutonium-239/240		107	N/A	-0.0460	10.4	0.834	1.68
Radium-226		6	N/A	0.870	1.08	0.954	0.0957
Radium-228		12	N/A	1.17	1.74	1.45	0.201
Strontium-89/90		12	N/A	0.119	0.800	0.322	0.218
Uranium-233/234		78	N/A	0.481	2.80	1.02	0.325
Uranium-235		78	N/A	-0.0238	0.232	0.0538	0.0471
Uranium-238		78	N/A	0.495	1.83	1.02	0.249

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.6
Summary of Detected Analytes in Surface Soil (PMJM Habitat)

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		62	100	4,780	21,600	10,537	3,345
Antimony		61	34.4	0.290	26.5	7.75	6.55
Arsenic		62	100	1.80	7.80	4.95	1.56
Barium		62	100	42.3	231	139	35.9
Beryllium		62	51.6	0.310	1.20	0.560	0.268
Boron		3	100	3.90	9.60	6.47	2.89
Cadmium		62	41.9	0.230	2.70	0.648	0.472
Calcium		62	100	3,300	161,000	12,864	20,615
Cesium[c]		52	67.3	1.90	6.10	9.70	19.4
Chromium		62	100	2.20	20.6	11.5	3.69
Cobalt		62	95.2	3.10	18.8	8.30	3.08
Copper		61	100	2.20	61.6	20.0	10.3
Iron		62	100	3,680	34,600	15,115	5,359
Lead		62	100	3.90	62	26.2	12.5
Lithium		61	68.9	2.40	16.7	7.16	3.00
Magnesium		62	100	1,620	11,400	3,302	1,887
Manganese		62	100	67	823	256	133
Mercury		61	24.6	0.0240	0.340	0.0510	0.0528
Molybdenum		61	11.5	0.260	0.900	1.49	0.727
Nickel		62	100	7.50	25	14.2	3.68
Nitrate / Nitrite		37	94.6	0.216	6.62	1.61	1.66
Potassium		62	100	690	4,520	2,011	670
Selenium		62	11.3	0.430	0.700	0.466	0.577
Silica[c]		3	100	261	930	670	359
Silicon[c]		5	100	1,240	4,570	2,720	1,319
Silver		61	19.7	0.210	52.7	1.92	6.81
Sodium		62	87.1	46	1,650	260	281
Strontium		61	100	14	151	47.8	25.2
Thallium		60	28.3	0.230	1.20	0.227	0.216
Tin		61	18.0	2.90	29.7	7.34	5.69
Titanium[c]		3	100	75	242	136	92.4
Vanadium		62	100	12.1	75.9	33.1	11.1
Zinc		62	100	15	650	81.0	82.6
Organics (µg/kg)							
Acetone[c]		8	25	57	61	26.0	33.8
Aroclor-1254		49	6.12	46	110	81.7	19.8
Aroclor-1260		49	6.12	57	160	83.4	21.7
Benzo(b)fluoranthene		10	30	76	210	192	48.7
Benzo(k)fluoranthene		10	30	86	220	196	44.9

Table 1.6
Summary of Detected Analytes in Surface Soil (PMJM Habitat)

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzoic Acid		10	30	180	200	928	731
bis(2-ethylhexyl)phthalate		10	40	29	1,100	365	384
Butylbenzylphthalate		10	10	140	140	290	269
Di-n-butylphthalate		10	10	79	79	284	273
Di-n-octylphthalate		10	10	570	570	333	276
Fluoranthene		10	30	65	590	259	150
Indeno(1,2,3-cd)pyrene		10	30	51	140	178	60.7
Methylene Chloride[c]		8	37.5	12	34	10.4	13.2
Pyrene		10	40	51	440	229	108
Tetrachloroethene		9	33.3	2	3	3.05	1.48
Toluene		9	11.1	130	130	16.2	42.7
Trichloroethene		9	33.3	2	2	2.80	1.58
Radionuclides (pCi/g)[d]							
Americium-241		53	N/A	0.00257	4.48	0.483	0.727
Cesium-134		7	N/A	-0.0847	0.120	0.0278	0.0727
Cesium-137		7	N/A	0.00300	0.680	0.283	0.250
Gross Alpha		27	N/A	5	28	14.9	4.98
Gross Beta		45	N/A	20.3	71.7	29.8	9.55
Plutonium-239/240		66	N/A	0.00700	10.4	1.35	2.25
Radium-226		3	N/A	0.900	1.08	1.02	0.102
Radium-228		4	N/A	1.20	1.42	1.30	0.122
Strontium-89/90		4	N/A	0.180	0.250	0.216	0.0298
Uranium-233/234		56	N/A	0.378	2.80	0.991	0.338
Uranium-235		56	N/A	-8.67E-04	0.216	0.0544	0.0438
Uranium-238		56	N/A	0.370	1.83	1.01	0.250

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		95	100	2,180	42,500	10,076	6,044
Antimony	0.32 - 16.4	89	6.74	0.440	18.6	5.67	3.13
Arsenic		95	100	1.10	15.1	4.79	2.49
Barium		95	100	22.9	783	142	89.2
Beryllium	0.24 - 1.2	95	71.6	0.330	2.10	0.742	0.360
Boron	0.37 - 0.39	14	85.7	2.90	8.80	5.41	2.87
Cadmium	0.043 - 1.2	95	20	0.0500	2.30	0.495	0.318
Calcium		95	100	1,180	203,000	30,500	38,215
Cesium	0.69 - 134	76	21.1	0.710	6.80	13.6	21.8
Chromium	1.2 - 1.2	95	98.9	2.20	32.5	11.0	5.89
Cobalt	2.2 - 2.2	95	98.9	0.780	55	7.73	6.26
Copper		95	100	3.10	34.1	12.8	5.72
Iron		95	100	3,340	110,000	14,650	13,993
Lead		95	100	2	84.9	13.8	8.67
Lithium	0.76 - 23.6	83	53.0	3.70	30.6	8.30	6.88
Magnesium		95	100	899	6,090	2,825	960
Manganese		95	100	17.9	1,400	199	182
Mercury	0.05 - 0.12	90	34.4	0.0230	0.270	0.0550	0.0438
Molybdenum	0.1 - 4.9	95	21.1	0.250	6.30	1.99	0.981
Nickel	4.2 - 9.7	95	83.2	5.20	190	15.7	19.8
Nitrate / Nitrite		11	100	1.60	25.1	4.82	6.95
Potassium	561 - 797	95	83.2	568	3,660	1,172	606
Selenium	0.14 - 2.5	85	18.8	0.280	5.80	0.365	0.641
Silica		14	100	347	1,300	851	267
Silicon[c]		10	100	810	3,590	1,613	1,046
Silver	0.05 - 2.5	94	12.8	0.0770	7.70	0.750	0.970
Sodium	85.4 - 245	95	82.1	52.2	860	178	136
Strontium		95	100	12.2	506	81.1	62.9
Thallium	0.21 - 1	92	14.1	0.230	0.630	0.175	0.102
Tin	0.53 - 23.7	95	8.42	1.30	52.2	9.50	8.92
Titanium		14	100	20	286	97.6	83.2
Uranium	0.99 - 3.3	18	11.1	2.80	5.70	1.24	1.27
Vanadium		95	100	11.2	73.9	29.1	12.5
Zinc		95	100	10.8	706	55.6	77.0
Organics (ug/kg)							
1,1,1-Trichloroethane	5 - 740	134	0.746	6	6	23.2	80.1
1,1-Dichloroethene	5 - 740	137	0.730	3	3	22.8	79.3
1,2,3-Trichlorobenzene[c]	5 - 6.8	20	5	1.20	1.20	2.81	0.429
1,2,4-Trichlorobenzene[c]	5 - 6.8	20	5	1	1	2.80	0.469

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
1,2,4-Trimethylbenzene	5 - 6.8	20	5	0.190	0.190	2.76	0.638
1,2-Dichloroethene	5 - 740	117	2.56	2	11	26.3	85.4
1234678-HpCDF	0.00135 - 0.00166	5	40	1.39E-04	5.01E-04	5.67E-04	2.66E-04
1234789-HpCDF	0.00135 - 0.00138	5	40	1.82E-04	3.40E-04	5.15E-04	2.39E-04
123478-HxCDF	0.00135 - 0.00166	5	20	2.56E-04	2.56E-04	6.28E-04	2.17E-04
2378-TCDD	5.4E-04 - 6.66E-04	5	20	2.26E-04	2.26E-04	2.76E-04	3.80E-05
2-Butanone	6 - 33	122	30.3	2	3,700	207	556
2-Hexanone	6 - 1500	130	0.769	0.820	0.820	48.5	163
4-Methyl-2-pentanone	6 - 1500	129	2.33	5	21	49.0	164
Acetone	10 - 2,300	132	21.2	3	5,100	185	713
Aroclor-1254	720 - 900	10	20	220	320	69.6	108
Benzo(a)anthracene	720 - 790	10	10	84	84	356	99.0
bis(2-ethylhexyl)phthalate	5 - 740	10	30	250	490	389	65.9
Carbon Disulfide	5 - 740	137	2.19	0.370	7.20	22.9	79.3
Carbon Tetrachloride	5 - 740	133	2.26	0.330	110	24.1	80.8
Chlorobenzene	5 - 740	137	0.730	74	74	23.4	79.4
Chloroform	720 - 900	138	13.0	0.250	84	24.2	79.1
Chrysene	0.00135 - 0.00138	10	10	79	79	356	101
Heptachlorodibenzo-p-dioxin	5 - 3700	5	40	7.08E-04	0.00156	8.65E-04	3.89E-04
Methylene Chloride	5 - 6.8	138	23.9	0.940	190	92.8	371
Naphthalene[c]	5 - 6.8	20	10	1	1.50	2.74	0.553
n-Butylbenzene[c]	0.00275 - 0.00276	20	5	0.270	0.270	2.77	0.621
OCDD	0.0027 - 0.00333	5	60	5.18E-04	0.00835	0.00308	0.00319
OCDF	36 - 45	5	20	6.50E-04	6.50E-04	0.00128	3.77E-04
Tetrachloroethene	5 - 740	137	13.1	1.40	56	23.4	79.3
Toluene	5 - 740	138	58.7	0.260	670	70.0	119
Trichloroethene	5 - 740	138	23.2	0.540	3,500	69.7	315
Trichlorofluoromethane[c]	5 - 6.8	20	5	2	2	2.86	0.293
Xylene	5 - 740	138	1.45	4	8	22.7	79.0
Radionuclides (pCi/g)[d]							
Americium-241		95	N/A	-0.0371	4.28	0.307	0.812
Cesium-134		6	N/A	-0.0918	0.0199	-0.0518	0.0410
Cesium-137		7	N/A	-0.0433	0.174	0.0618	0.0957
Gross Alpha		70	N/A	5.20	35	14.1	5.35
Gross Beta		74	N/A	11	37	21.8	5.36
Plutonium-238		9	N/A	-0.00100	0.00500	0.00222	0.00228

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Plutonium-239/240		92	N/A	-0.00500	9.75	0.656	1.72
Radium-226		5	N/A	0.377	2.96	1.70	1.09
Radium-228		7	N/A	1.28	1.87	1.57	0.210
Strontium-89/90		7	N/A	-6.58E-04	0.102	0.0509	0.0355
Uranium-233/234		106	N/A	0.0210	2.24	0.940	0.373
Uranium-235		106	N/A	-0.0166	0.261	0.0528	0.0530
Uranium-238		106	N/A	0	2.22	0.960	0.404

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Surface Soil/Surface Sediment (ug/kg)							
CW54-000	05F0275-001	1234678-HpCDF	0.00251	Yes	V1	0.0100	2.51E-05
CW54-000	05F0275-001	1234789-HpCDF	0.00286	No	V1	0.0100	0
CW54-000	05F0275-001	123478-HxCDD	0.00286	No	V1	0.100	0
CW54-000	05F0275-001	123478-HxCDF	5.66E-04	Yes	V1	0.100	5.66E-05
CW54-000	05F0275-001	123678-HxCDD	0.00122	Yes	V1	0.100	1.22E-04
CW54-000	05F0275-001	123678-HxCDF	0.00286	No	V1	0.100	0
CW54-000	05F0275-001	123789-HxCDD	0.00106	Yes	V1	0.100	1.06E-04
CW54-000	05F0275-001	123789-HxCDF	0.00286	No	V1	0.100	0
CW54-000	05F0275-001	12378-PeCDF	0.00286	No	V1	0.0500	0
CW54-000	05F0275-001	234678-HxCDF	0.00286	No	V1	0.100	0
CW54-000	05F0275-001	23478-PeCDF	0.00286	No	V1	0.500	0
CW54-000	05F0275-001	2378-TCDD	0.00114	No	V1	1	0
CW54-000	05F0275-001	2378-TCDF	0.00114	No	V1	0.100	0
CW54-000	05F0275-001	Heptachlorodibenzo-p-dioxin	0.0199	Yes	V1	0.0100	1.99E-04
CW54-000	05F0275-001	OCDD	0.161	Yes	V1	1.00E-04	1.61E-05
CW54-000	05F0275-001	OCDF	0.00883	Yes	V1	1.00E-04	8.83E-07
CW54-000	05F0275-001	Pentachlorodibenzo-p-dioxin	0.00286	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-001:							**5.26E-04**
2,3,7,8-TCDD TEQ Concentration used in Surface Soil/Surface Sediment PRG Screen[c]:							**5.26E-04**
Subsurface Soil/Subsurface Sediment (ug/kg)							
CW54-000	05F0275-002	1234678-HpCDF	0.00419	No	V1	0.0100	0
CW54-000	05F0275-002	1234789-HpCDF	7.40E-04	Yes	V1	0.0100	7.40E-06
CW54-000	05F0275-002	123478-HxCDD	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	123478-HxCDF	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	123678-HxCDD	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	123678-HxCDF	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	123789-HxCDD	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	123789-HxCDF	5.53E-04	Yes	V1	0.100	5.53E-05
CW54-000	05F0275-002	12378-PeCDF	0.00419	No	V1	0.0500	0
CW54-000	05F0275-002	234678-HxCDF	0.00419	No	V1	0.100	0
CW54-000	05F0275-002	23478-PeCDF	0.00419	No	V1	0.500	0
CW54-000	05F0275-002	2378-TCDD	0.00168	No	V1	1	0
CW54-000	05F0275-002	2378-TCDF	0.00168	No	V1	0.100	0
CW54-000	05F0275-002	Heptachlorodibenzo-p-dioxin	0.00419	No	V1	0.0100	0
CW54-000	05F0275-002	OCDD	0.0178	Yes	V1	1.00E-04	1.78E-06
CW54-000	05F0275-002	OCDF	0.00838	No	V1	1.00E-04	0
CW54-000	05F0275-002	Pentachlorodibenzo-p-dioxin	0.00419	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-002:							**6.45E-05**
CW54-000	05F0275-003	1234678-HpCDF	0.00283	Yes	V1	0.0100	2.83E-05
CW54-000	05F0275-003	1234789-HpCDF	7.70E-04	Yes	V1	0.0100	7.70E-06
CW54-000	05F0275-003	123478-HxCDD	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	123478-HxCDF	5.50E-04	Yes	V1	0.100	5.50E-05

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
CW54-000	05F0275-003	123678-HxCDD	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	123678-HxCDF	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	123789-HxCDD	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	123789-HxCDF	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	12378-PeCDF	0.00474	No	V1	0.0500	0
CW54-000	05F0275-003	234678-HxCDF	0.00474	No	V1	0.100	0
CW54-000	05F0275-003	23478-PeCDF	0.00474	No	V1	0.500	0
CW54-000	05F0275-003	2378-TCDD	0.00190	No	V1	1	0
CW54-000	05F0275-003	2378-TCDF	0.00190	No	V1	0.100	0
CW54-000	05F0275-003	Heptachlorodibenzo-p-dioxin	0.0198	Yes	V1	0.0100	1.98E-04
CW54-000	05F0275-003	OCDD	0.114	Yes	V1	1.00E-04	1.14E-05
CW54-000	05F0275-003	OCDF	0.00583	Yes	V1	1.00E-04	5.83E-07
CW54-000	05F0275-003	Pentachlorodibenzo-p-dioxin	0.00474	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-003:							**3.01E-04**
CW54-000	05F0275-004	1234678-HpCDF	0.00166	No	V1	0.0100	0
CW54-000	05F0275-004	1234789-HpCDF	3.40E-04	Yes	V1	0.0100	3.40E-06
CW54-000	05F0275-004	123478-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123478-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123678-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123678-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123789-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123789-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	12378-PeCDF	0.00166	No	V1	0.0500	0
CW54-000	05F0275-004	234678-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	23478-PeCDF	0.00166	No	V1	0.500	0
CW54-000	05F0275-004	2378-TCDD	6.66E-04	No	V1	1	0
CW54-000	05F0275-004	2378-TCDF	6.66E-04	No	V1	0.100	0
CW54-000	05F0275-004	Heptachlorodibenzo-p-dioxin	0.00156	Yes	V1	0.0100	1.56E-05
CW54-000	05F0275-004	OCDD	0.00835	Yes	V1	1.00E-04	8.35E-07
CW54-000	05F0275-004	OCDF	0.00333	No	V1	1.00E-04	0
CW54-000	05F0275-004	Pentachlorodibenzo-p-dioxin	0.00166	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-004:							**1.98E-05**
CW54-000	05F0275-005	1234678-HpCDF	1.39E-04	Yes	V1	0.0100	1.39E-06
CW54-000	05F0275-005	1234789-HpCDF	0.00138	No	V1	0.0100	0
CW54-000	05F0275-005	123478-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123478-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123678-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123678-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123789-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123789-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	12378-PeCDF	0.00138	No	V1	0.0500	0
CW54-000	05F0275-005	234678-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	23478-PeCDF	0.00138	No	V1	0.500	0
CW54-000	05F0275-005	2378-TCDD	5.50E-04	No	V1	1	0

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
CW54-000	05F0275-005	2378-TCDF	5.50E-04	No	V1	0.100	0
CW54-000	05F0275-005	Heptachlorodibenzo-p-dioxin	0.00138	No	V1	0.0100	0
CW54-000	05F0275-005	OCDD	0.00275	No	V1	1.00E-04	0
CW54-000	05F0275-005	OCDF	0.00275	No	V1	1.00E-04	0
CW54-000	05F0275-005	Pentachlorodibenzo-p-dioxin	0.00138	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-005:							**1.39E-06**
CS53-000	05F0348-002	1234678-HpCDF	0.0298	Yes	V1	0.0100	2.98E-04
CS53-000	05F0348-002	1234789-HpCDF	0.00243	Yes	V1	0.0100	2.43E-05
CS53-000	05F0348-002	123478-HxCDD	0.00126	Yes	V1	0.100	1.26E-04
CS53-000	05F0348-002	123478-HxCDF	0.00371	Yes	V1	0.100	3.71E-04
CS53-000	05F0348-002	123678-HxCDD	0.00455	Yes	V1	0.100	4.55E-04
CS53-000	05F0348-002	123678-HxCDF	0.00250	Yes	V1	0.100	2.50E-04
CS53-000	05F0348-002	123789-HxCDD	0.00329	Yes	V1	0.100	3.29E-04
CS53-000	05F0348-002	123789-HxCDF	0.00184	No	V1	0.100	0
CS53-000	05F0348-002	12378-PeCDF	0.00197	Yes	V1	0.0500	9.85E-05
CS53-000	05F0348-002	234678-HxCDF	0.00199	Yes	V1	0.100	1.99E-04
CS53-000	05F0348-002	23478-PeCDF	0.00429	Yes	V1	0.500	0.00215
CS53-000	05F0348-002	2378-TCDD	0.00278	Yes	V1	1	0.00278
CS53-000	05F0348-002	2378-TCDF	0.00612	Yes	J1	0.100	6.12E-04
CS53-000	05F0348-002	Heptachlorodibenzo-p-dioxin	0.0946	Yes	V1	0.0100	9.46E-04
CS53-000	05F0348-002	OCDD	0.539	Yes	V1	1.00E-04	5.39E-05
CS53-000	05F0348-002	OCDF	0.0409	Yes	V1	1.00E-04	4.09E-06
CS53-000	05F0348-002	Pentachlorodibenzo-p-dioxin	0.00184	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-002:							**0.00869**
CS53-000	05F0348-003	1234678-HpCDF	5.01E-04	Yes	V1	0.0100	5.01E-06
CS53-000	05F0348-003	1234789-HpCDF	1.82E-04	Yes	V1	0.0100	1.82E-06
CS53-000	05F0348-003	123478-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123478-HxCDF	2.56E-04	Yes	V1	0.100	2.56E-05
CS53-000	05F0348-003	123678-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123678-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123789-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123789-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	12378-PeCDF	0.00140	No	V1	0.0500	0
CS53-000	05F0348-003	234678-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	23478-PeCDF	0.00140	No	V1	0.500	0
CS53-000	05F0348-003	2378-TCDD	2.26E-04	Yes	V1	1	2.26E-04
CS53-000	05F0348-003	2378-TCDF	5.59E-04	No	V1	0.100	0
CS53-000	05F0348-003	Heptachlorodibenzo-p-dioxin	7.08E-04	Yes	V1	0.0100	7.08E-06
CS53-000	05F0348-003	OCDD	0.00379	Yes	V1	1.00E-04	3.79E-07
CS53-000	05F0348-003	OCDF	6.50E-04	Yes	V1	1.00E-04	6.50E-08
CS53-000	05F0348-003	Pentachlorodibenzo-p-dioxin	0.00140	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-003:							**2.66E-04**
CS53-000	05F0348-004	1234678-HpCDF	0.00138	No	V1	0.0100	0
CS53-000	05F0348-004	1234789-HpCDF	0.00138	No	V1	0.0100	0

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
CS53-000	05F0348-004	123478-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123478-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123678-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123678-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123789-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123789-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	12378-PeCDF	0.00138	No	V1	0.0500	0
CS53-000	05F0348-004	234678-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	23478-PeCDF	0.00138	No	V1	0.500	0
CS53-000	05F0348-004	2378-TCDD	5.52E-04	No	V1	1	0
CS53-000	05F0348-004	2378-TCDF	5.52E-04	No	V1	0.100	0
CS53-000	05F0348-004	Heptachlorodibenzo-p-dioxin	0.00138	No	V1	0.0100	0
CS53-000	05F0348-004	OCDD	0.00276	No	V1	1.00E-04	0
CS53-000	05F0348-004	OCDF	0.00276	No	V1	1.00E-04	0
CS53-000	05F0348-004	Pentachlorodibenzo-p-dioxin	0.00138	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-004:							**0**
CS53-000	05F0348-005	1234678-HpCDF	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	1234789-HpCDF	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	123478-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123478-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123678-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123678-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123789-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123789-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	12378-PeCDF	0.00135	No	V1	0.0500	0
CS53-000	05F0348-005	234678-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	23478-PeCDF	0.00135	No	V1	0.500	0
CS53-000	05F0348-005	2378-TCDD	5.40E-04	No	V1	1	0
CS53-000	05F0348-005	2378-TCDF	5.40E-04	No	V1	0.100	0
CS53-000	05F0348-005	Heptachlorodibenzo-p-dioxin	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	OCDD	5.18E-04	Yes	V1	1.00E-04	5.18E-08
CS53-000	05F0348-005	OCDF	0.00270	No	V1	1.00E-04	0
CS53-000	05F0348-005	Pentachlorodibenzo-p-dioxin	0.00135	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-005:							**5.18E-08**
2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil/Subsurface Sediment PRG Screen[c]:							**0.00869**

[a]Toxicity Equivalency Factor (WHO, 1997).

[b]TEQ (Toxicity Equivalence) Concentration = Soil Concentration x TEF. For non-detects, the TEQ Concentration equals zero.

[c]The 2,3,7,8-TCDD TEQ concentration used in the PRG screen is the maximum of all sampling locations for the medium.

V1 = No problems with the data validation.

J1 = All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

Table 1.9
Toxicity Equivalence Calculation for Dioxins/Furans-Ecological Receptors

						Mammals	
Sampling Location	**Sample Number**	**Congener**	**Result**	**Detect?**	**Validation Qualifier**	**TEF [a]**	**TEQ Concentration[b]**
Subsurface Soil							
CW54-000	05F0275-004	1234678-HpCDF	0.00166	No	V1	0.0100	0
CW54-000	05F0275-004	1234789-HpCDF	3.40E-04	Yes	V1	0.0100	3.40E-06
CW54-000	05F0275-004	123478-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123478-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123678-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123678-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123789-HxCDD	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	123789-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	12378-PeCDF	0.00166	No	V1	0.0500	0
CW54-000	05F0275-004	234678-HxCDF	0.00166	No	V1	0.100	0
CW54-000	05F0275-004	23478-PeCDF	0.00166	No	V1	0.500	0
CW54-000	05F0275-004	2378-TCDD	6.66E-04	No	V1	1	0
CW54-000	05F0275-004	2378-TCDF	6.66E-04	No	V1	0.100	0
CW54-000	05F0275-004	Heptachlorodibenzo-p-dioxin	0.00156	Yes	V1	0.0100	1.56E-05
CW54-000	05F0275-004	OCDD	0.00835	Yes	V1	1.00E-04	8.35E-07
CW54-000	05F0275-004	OCDF	0.00333	No	V1	1.00E-04	0
CW54-000	05F0275-004	Pentachlorodibenzo-p-dioxin	0.00166	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-004:							**1.98E-05**
CW54-000	05F0275-005	1234678-HpCDF	1.39E-04	Yes	V1	0.0100	1.39E-06
CW54-000	05F0275-005	1234789-HpCDF	0.00138	No	V1	0.0100	0
CW54-000	05F0275-005	123478-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123478-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123678-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123678-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123789-HxCDD	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	123789-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	12378-PeCDF	0.00138	No	V1	0.0500	0
CW54-000	05F0275-005	234678-HxCDF	0.00138	No	V1	0.100	0
CW54-000	05F0275-005	23478-PeCDF	0.00138	No	V1	0.500	0
CW54-000	05F0275-005	2378-TCDD	5.50E-04	No	V1	1	0
CW54-000	05F0275-005	2378-TCDF	5.50E-04	No	V1	0.100	0
CW54-000	05F0275-005	Heptachlorodibenzo-p-dioxin	0.00138	No	V1	0.0100	0
CW54-000	05F0275-005	OCDD	0.00275	No	V1	1.00E-04	0
CW54-000	05F0275-005	OCDF	0.00275	No	V1	1.00E-04	0
CW54-000	05F0275-005	Pentachlorodibenzo-p-dioxin	0.00138	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0275-005:							**1.39E-06**
CS53-000	05F0348-003	1234678-HpCDF	5.01E-04	Yes	V1	0.0100	5.01E-06
CS53-000	05F0348-003	1234789-HpCDF	1.82E-04	Yes	V1	0.0100	1.82E-06
CS53-000	05F0348-003	123478-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123478-HxCDF	2.56E-04	Yes	V1	0.100	2.56E-05

Table 1.9
Toxicity Equivalence Calculation for Dioxins/Furans-Ecological Receptors

						Mammals	
Sampling Location	**Sample Number**	**Congener**	**Result**	**Detect?**	**Validation Qualifier**	**TEF [a]**	**TEQ Concentration[b]**
CS53-000	05F0348-003	123678-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123678-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123789-HxCDD	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	123789-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	12378-PeCDF	0.00140	No	V1	0.0500	0
CS53-000	05F0348-003	234678-HxCDF	0.00140	No	V1	0.100	0
CS53-000	05F0348-003	23478-PeCDF	0.00140	No	V1	0.500	0
CS53-000	05F0348-003	2378-TCDD	2.26E-04	Yes	V1	1	2.26E-04
CS53-000	05F0348-003	2378-TCDF	5.59E-04	No	V1	0.100	0
CS53-000	05F0348-003	Heptachlorodibenzo-p-dioxin	7.08E-04	Yes	V1	0.0100	7.08E-06
CS53-000	05F0348-003	OCDD	0.00379	Yes	V1	1.00E-04	3.79E-07
CS53-000	05F0348-003	OCDF	6.50E-04	Yes	V1	1.00E-04	6.50E-08
CS53-000	05F0348-003	Pentachlorodibenzo-p-dioxin	0.00140	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-003:							**2.66E-04**
CS53-000	05F0348-004	1234678-HpCDF	0.00138	No	V1	0.0100	0
CS53-000	05F0348-004	1234789-HpCDF	0.00138	No	V1	0.0100	0
CS53-000	05F0348-004	123478-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123478-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123678-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123678-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123789-HxCDD	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	123789-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	12378-PeCDF	0.00138	No	V1	0.0500	0
CS53-000	05F0348-004	234678-HxCDF	0.00138	No	V1	0.100	0
CS53-000	05F0348-004	23478-PeCDF	0.00138	No	V1	0.500	0
CS53-000	05F0348-004	2378-TCDD	5.52E-04	No	V1	1	0
CS53-000	05F0348-004	2378-TCDF	5.52E-04	No	V1	0.100	0
CS53-000	05F0348-004	Heptachlorodibenzo-p-dioxin	0.00138	No	V1	0.0100	0
CS53-000	05F0348-004	OCDD	0.00276	No	V1	1.00E-04	0
CS53-000	05F0348-004	OCDF	0.00276	No	V1	1.00E-04	0
CS53-000	05F0348-004	Pentachlorodibenzo-p-dioxin	0.00138	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-004:							**0**
CS53-000	05F0348-005	1234678-HpCDF	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	1234789-HpCDF	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	123478-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123478-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123678-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123678-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123789-HxCDD	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	123789-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	12378-PeCDF	0.00135	No	V1	0.0500	0

Table 1.9
Toxicity Equivalence Calculation for Dioxins/Furans-Ecological Receptors

						Mammals	
Sampling Location	**Sample Number**	**Congener**	**Result**	**Detect?**	**Validation Qualifier**	**TEF [a]**	**TEQ Concentration[b]**
CS53-000	05F0348-005	234678-HxCDF	0.00135	No	V1	0.100	0
CS53-000	05F0348-005	23478-PeCDF	0.00135	No	V1	0.500	0
CS53-000	05F0348-005	2378-TCDD	5.40E-04	No	V1	1	0
CS53-000	05F0348-005	2378-TCDF	5.40E-04	No	V1	0.100	0
CS53-000	05F0348-005	Heptachlorodibenzo-p-dioxin	0.00135	No	V1	0.0100	0
CS53-000	05F0348-005	OCDD	5.18E-04	Yes	V1	1.00E-04	5.18E-08
CS53-000	05F0348-005	OCDF	0.00270	No	V1	1.00E-04	0
CS53-000	05F0348-005	Pentachlorodibenzo-p-dioxin	0.00135	No	V1	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 05F0348-005:							**5.18E-08**
2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil ESL Screen[c]:							**2.66E-04**

[a]Toxicity Equivalency Factor (WHO, 1997).
[b]TEQ (Toxicity Equivalence) Concentration = Soil Concentration x TEF. For non-detects, the TEQ Concentration equals zero.
[c]The 2,3,7,8-TCDD TEQ concentration used in the ESL screen is the maximum of all sampling locations for the medium.
N/A = Not applicable.
V1 = No problems with the data validation.

Table 2.1
Essential Nutrient Screen for Surface Soil/Surface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	92,000	9.20	500-1,200	2,500	No
Magnesium	12,200	1.22	80-420	65-110	No
Potassium	4,430	0.443	2,000-3,500	N/A	No
Sodium	1,650	0.165	500-2,400	N/A	No

[a] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	24,774	29,000	Yes	13,627	No	No
Antimony	44.4	43.6	No	--	--	No
Arsenic	**2.41**	**11**	**Yes**	**5.61**	**Yes**	**Yes**
Barium	2,872	272	No	--	--	No
Beryllium	100	1.50	No	--	--	No
Boron	9,477	30	No	--	--	No
Cadmium	91.4	3.10	No	--	--	No
Cesium	N/A	7.30	UT	--	--	UT
Chloride	N/A	83.8	UT	--	--	UT
Chromium[c]	28.4	66.5	Yes	14.4	No	No
Chromium VI	28.4	0.00700	No	--	--	No
Cobalt	122	20.1	No	--	--	No
Copper	4,443	61.6	No	--	--	No
Fluoride	6,665	4.55	No	--	--	No
Iron	33,326	37,100	Yes	16,961	No	No
Lead	1,000	234	No	--	--	No
Lithium	2,222	24	No	--	--	No
Manganese	419	1,760	Yes	335	No	No
Mercury	32.9	0.220	No	--	--	No
Molybdenum	555	19.1	No	--	--	No
Nickel	2,222	31.6	No	--	--	No
Nitrate / Nitrite[d]	177,739	19	No	--	--	No
Selenium	555	2.40	No	--	--	No
Silica	N/A	3,300	UT	--	--	UT
Silicon	N/A	4,570	UT	--	--	UT
Silver	555	8.90	No	--	--	No
Strontium	66,652	255	No	--	--	No
Thallium	7.78	1.20	No	--	--	No
Tin	66,652	39.5	No	--	--	No
Titanium	169,568	844	No	--	--	No
Uranium	333	4.30	No	--	--	No
Vanadium	111	75.9	No	--	--	No
Zinc	33,326	540	No	--	--	No
Organics (µg/kg)						
2,3,7,8-TCDD TEQ[e]	0.0248	5.26E-04	No	--	--	No
2-Butanone	4.64E+07	43	No	--	--	No
2-Methylnaphthalene	320,574	120	No	--	--	No
4,4'-DDE	10,961	4.10	No	--	--	No
4,4'-DDT	10,927	4.90	No	--	--	No
Acenaphthene	4.44E+06	620	No	--	--	No

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Acetone	1.00E+08	230	No	--	--	No
Aldrin	176	54	No	--	--	No
Anthracene	2.22E+07	970	No	--	--	No
Aroclor-1254	1,349	590	No	--	--	No
Aroclor-1260	1,349	160	No	--	--	No
Benzene	23,563	3	No	--	--	No
Benzo(a)anthracene	3,793	1,400	No	--	--	No
Benzo(a)pyrene	**379**	**1,300**	**Yes**	**541**	**Yes**	**Yes**
Benzo(b)fluoranthene	3,793	1,500	No	--	--	No
Benzo(g,h,i)perylene	N/A	480	UT	--	--	UT
Benzo(k)fluoranthene	37,927	1,100	No	--	--	No
Benzoic Acid	3.21E+08	220	No	--	--	No
bis(2-ethylhexyl)phthalate	213,750	3,600	No	--	--	No
Butylbenzylphthalate	1.60E+07	220	No	--	--	No
Carbazole	150,001	56	No	--	--	No
Carbon Tetrachloride	8,446	440	No	--	--	No
Chrysene	379,269	1,500	No	--	--	No
delta-BHC	570	13	No	--	--	No
Dibenz(a,h)anthracene	379	92	No	--	--	No
Dibenzofuran	222,174	300	No	--	--	No
Dieldrin	187	4.60	No	--	--	No
Di-n-butylphthalate	8.01E+06	190	No	--	--	No
Di-n-octylphthalate	3.21E+06	570	No	--	--	No
Endosulfan I	480,861	20	No	--	--	No
Fluoranthene	2.96E+06	3,100	No	--	--	No
Fluorene	3.21E+06	650	No	--	--	No
Indeno(1,2,3-cd)pyrene	3,793	490	No	--	--	No
Methoxychlor	400,718	2.70	No	--	--	No
Methylene Chloride	271,792	420	No	--	--	No
Naphthalene	1.40E+06	290	No	--	--	No
Phenanthrene	N/A	3,300	UT	--	--	UT
Pyrene	2.22E+06	3,900	No	--	--	No
Tetrachloroethene	6,705	4	No	--	--	No
Toluene	3.09E+06	130	No	--	--	No
Trichloroethene	1,770	2	No	--	--	No
Trichlorofluoromethane	1.51E+06	4	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	7.69	6.89	No	--	--	No
Cesium-134	0.0800	0.200	Yes	0.0767	No	No
Cesium-137	**0.221**	**0.680**	**Yes**	**0.278**	**Yes**	**Yes**
Gross Alpha	N/A	39.6	UT	--	--	UT

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Gross Beta	N/A	71.7	UT	--	--	UT
Plutonium-239/240	9.80	22.4	Yes	1.99	No	No
Radium-226	2.69	3.08	Yes	2.01	No	No
Radium-228	**0.111**	**2.40**	**Yes**	**1.77**	**Yes**	**Yes**
Strontium-89/90	13.2	1.80	No	--	--	No
Uranium-233/234	25.3	3.70	No	--	--	No
Uranium-235	1.05	0.285	No	--	--	No
Uranium-238	29.3	6.10	No	--	--	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used.

[d] The PRG for nitrate is used.

[e] The TEQ for 2378-TCDD is calculated in Table 1.8 and the PRG for 2378-TCDD is used in the PRG screen.

N/A = Not available.
UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.3
Statistical Distributions and Comparison to Background for UWNEU[a]

Analyte	Statistical Distribution Testing Results						Background Comparison		
	Background			UWNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1-p	Retain as PCOC?
Surface Soil/Surface Sediment									
Arsenic	**73**	**GAMMA**	**92**	**151**	**NORMAL**	**100**	**WRS**	**4.71E-09**	**Yes**
Cesium-137	105	NON-PARAMETRIC	100	62	GAMMA	N/A	WRS	1.000	No
Radium-228	40	GAMMA	100	46	NON-PARAMETRIC	N/A	WRS	0.222	No
Subsurface Soil/Subsurface Sediment									
Radium-228	**31**	**GAMMA**	**100**	**14**	**NORMAL**	**N/A**	**WRS**	**0.081**	**Yes**

[a] EU data used for background comparisons do not include data from background locations.
N/A = Not applicable; all radionuclide values are considered detect.
Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.4
Essential Nutrient Screen for Subsurface Soil/Subsurface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	203,000	20.3	500-1,200	2,500	No
Magnesium	11,000	1.10	80-420	65-110	No
Potassium	6,500	0.650	2,000-3,500	N/A	No
Sodium	1,500	0.150	500-2,400	N/A	No

[a] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	284,902	49,000	No	--	--	No
Antimony	511	30.4	No	--	--	No
Arsenic	27.7	15.1	No	--	--	No
Barium	33,033	783	No	--	--	No
Beryllium	1,151	2.50	No	--	--	No
Boron	108,980	26	No	--	--	No
Cadmium	1,051	44	No	--	--	No
Cesium	N/A	6.80	UT	--	--	UT
Chromium[c]	327	140	No	--	--	No
Cobalt	1,401	55	No	--	--	No
Copper	51,100	120	No	--	--	No
Iron	383,250	110,000	No	--	--	No
Lead	1,000	110	No	--	--	No
Lithium	25,550	37	No	--	--	No
Manganese	4,815	1,400	No	--	--	No
Mercury	379	1.70	No	--	--	No
Molybdenum	6,388	6.30	No	--	--	No
Nickel	25,550	190	No	--	--	No
Nitrate / Nitrite[d]	2.04E+06	52.9	No	--	--	No
Selenium	6,388	5.80	No	--	--	No
Silica	N/A	4,900	UT	--	--	UT
Silicon	N/A	3,590	UT	--	--	UT
Silver	6,388	3,100	No	--	--	No
Strontium	766,500	506	No	--	--	No
Sulfide	N/A	37	UT	--	--	UT
Thallium	89.4	0.720	No	--	--	No
Tin	766,500	52.2	No	--	--	No
Titanium	1.95E+06	310	No	--	--	No
Uranium	3,833	20	No	--	--	No
Vanadium	1,278	96	No	--	--	No
Zinc	383,250	706	No			No
Organics (µg/kg)						
1,1,1-Trichloroethane	1.06E+08	6	No	--	--	No
1,1-Dichloroethene	199,706	3	No	--	--	No
1,2,3-Trichlorobenzene	N/A	1.20	UT	--	--	UT
1,2,4-Trichlorobenzene	1.74E+06	1	No	--	--	No
1,2,4-Trimethylbenzene	1.53E+06	0.190	No	--	--	No
1,2-Dichloroethene	1.15E+07	11	No	--	--	No
2,3,7,8-TCDD TEQ[e]	0.285	0.00869	No	--	--	No
2-Butanone	5.33E+08	3,700	No	--	--	No

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
2-Hexanone	N/A	0.820	UT	--	--	UT
4-Methyl-2-pentanone	9.57E+08	21	No	--	--	No
Acenaphthene	5.10E+07	89	No	--	--	No
Acetone	1.15E+09	5,100	No	--	--	No
Anthracene	2.55E+08	420	No	--	--	No
Aroclor-1254	15,514	5,200	No	--	--	No
Aroclor-1260	15,514	150	No	--	--	No
Atrazine	156,820	120	No	--	--	No
Benzo(a)anthracene	43,616	430	No	--	--	No
Benzo(a)pyrene	4,357	570	No	--	--	No
Benzo(b)fluoranthene	43,616	1,500	No	--	--	No
Benzo(g,h,i)perylene	N/A	320	UT	--	--	UT
Benzo(k)fluoranthene	436,159	540	No	--	--	No
Benzoic Acid	3.69E+09	2,700	No	--	--	No
bis(2-ethylhexyl)phthalate	2.46E+06	47,000	No	--	--	No
Butylbenzylphthalate	1.84E+08	120	No	--	--	No
Carbon Disulfide	1.88E+07	7.20	No	--	--	No
Carbon Tetrachloride	97,124	110	No	--	--	No
Chlorobenzene	7.67E+06	74	No	--	--	No
Chloroform	90,270	84	No	--	--	No
Chrysene	4.36E+06	650	No	--	--	No
cis-1,2-Dichloroethene	1.28E+07	48	No	--	--	No
Dibenz(a,h)anthracene	4,362	110	No	--	--	No
Di-n-butylphthalate	9.22E+07	75	No	--	--	No
Di-n-octylphthalate	3.69E+07	250	No	--	--	No
Fluoranthene	3.40E+07	1,400	No	--	--	No
gamma-BHC (Lindane)	31,864	25	No	--	--	No
Indeno(1,2,3-cd)pyrene	43,616	300	No	--	--	No
Methylene Chloride	3.13E+06	190	No	--	--	No
Naphthalene	1.61E+07	1.50	No	--	--	No
n-Butylbenzene	N/A	0.270	UT	--	--	UT
Phenanthrene	N/A	760	UT	--	--	UT
Phenol	2.76E+08	54	No	--	--	No
Pyrene	2.55E+07	1,200	No	--	--	No
Tetrachloroethene	77,111	56	No	--	--	No
Toluene	3.56E+07	860	No	--	--	No
trans-1,2-Dichloroethene	3.30E+06	2	No	--	--	No
Trichloroethene	20,354	3,500	No			No
Trichlorofluoromethane	1.74E+07	2	No			No
Vinyl Chloride	24,948	16.8	No			No
Xylene[f]	1.22E+07	8	No			No
Radionuclides (pCi/g)						

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Americium-241	88.4	56.5	No	--	--	No
Cesium-134	0.910	0.0820	No	--	--	No
Cesium-137	2.54	0.832	No	--	--	No
Gross Alpha	N/A	70.7	UT	--	--	UT
Gross Beta	N/A	38	UT	--	--	UT
Plutonium-238	68.7	0.00500	No	--	--	No
Plutonium-239/240	112	217	Yes	10.6	No	No
Radium-226	31	2.96	No	--	--	No
Radium-228	**0.11**	**1.87**	**Yes**	**1.65**	**Yes**	**Yes**
Strontium-89/90	152	1.12	No	--	--	No
Uranium-233/234	291	6.04	No	--	--	No
Uranium-235	12.1	0.352	No	--	--	No
Uranium-238	337	8.51	No	--	--	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used.

[d] The PRG for nitrate is used.

[e] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the PRG for 2,3,7,8-TCDD is used in the PRG screen.

[d] The PRG for total xylene is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.6
Summary of the COC Selection Process

Analyte	MDC Exceeds PRG?	UCL Exceeds PRG?	Detection Frequency > 5%[a]	Exceeds 30X the PRG?	Exceeds Background?	Professional Judgment-Retain?	Retain as COC?
Surface Soil/Surface Sediment							
Aluminum	Yes	No	--	--	--	--	No
Arsenic	Yes	Yes	Yes	N/A	Yes	No	No
Chromium	Yes	No	--	--	--	--	No
Iron	Yes	No	--	--	--	--	No
Manganese	Yes	No	--	--	--	--	No
Benzo(a)pyrene	**Yes**	**Yes**	**Yes**	**N/A**	**N/A**	**Yes**	**Yes**
Cesium-134	Yes	No	--	--	--	--	No
Cesium-137	Yes	Yes	N/A	N/A	No	--	No
Plutonium-239/240	Yes	No	--	--	--	--	No
Radium-226	Yes	No	--	--	--	--	No
Radium-228	Yes	Yes	N/A	N/A	No	--	No
Subsurface Soil/ Subsurface Sediment							
Radium-228	Yes	Yes	N/A	N/A	Yes	No	No

[a] All radionuclide values are considered detects.

N/A = Not applicable.

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Bold = Analyte retained as COCs for risk characterization.

Table 3.1
Exposure Point Concentrations

Analyte	Unit	MDC[a]	UCL Value[b]	UCL Type	Distribution	EPC[c]
Tier 1						
Surface Soil/Surface Sediment						
Benzo(a)pyrene	mg/kg	1.30	0.541	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.541
Tier 2						
Surface Soil/Surface Sediment						
Benzo(a)pyrene	mg/kg	0.91	0.39	95% Approximate Gamma UCL	GAMMA	0.389

[a] The MDC for Tier 1 is the maximum detected concentration of all samples and the MDC for Tier 2 is the maximum of the average concentration of the samples in each of the 30-acre grids in the EU.

[b] UCL = upper confidence limit.

[c] The UCL is used as the EPC, unless the UCL exceeds the MDC, then the MDC is used for the EPC.

Table 3.2
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRwss x EFwss x EDw x CF_3) / (BW x [ATc_wss or ATn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Ingestion Rate of soil/sediment	IRwss	100	mg/day	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFo x MLF) / (BW x [ATc_wss or ATn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Inhalation Rate	IRawss	1.3	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, outdoor	ETFo	0.5	--	EPA et al. 2002
Mass loading, (PM 10) for inhalation[a]	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Indoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFi x DFi x MLF) / (BW x [ATc_wss or ATn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Inhalation Rate	IRawss	1.3	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002

Table 3.2
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, indoor	ETFi	0.5	--	EPA et al. 2002
Dilution Factor, indoor inhalation	DFi	0.7	--	EPA et al. 2002
Mass Loading, (PM 10) for inhalation[a]	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Adult Body Weight	BW	70	kg/m3	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Dermal Contact				
CI = (Cs x SAw x AFw x EFwss x EDw x ABS x EVw x CF_3) / (BW x [Atc_wss or Atn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Skin Surface Area[c]	SAw	3300	cm^2	EPA 2001
Skin-soil adherence factor	AFw	0.117	mg/cm^2-event	EPA 2001
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Absorption Fraction	ABS	chemical-specific		EPA 2001[c]
Event frequency	EVw	1	events/day	EPA 2001
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated

[a] The mass loading value is the 95th percentile of the estimated mass loading distribution estimated in the RSALs Task 3 Report (EPA et al. 2002).

[b] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[c] The skin surface area value is the EPA default for commercial/industrial exposures and is the average of the 50th percentile for men and women > 18 years old wearing a short-sleeved shirt, long pants, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

Table 3.3
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRagevss x EFvss x CF_3) / [Atc_vss or Atnc][a] **where, IRageav = ((IRvss x EDav) / BW) + ((IRcvss x EDcv) / BWc)**				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Age-adjusted Soil Ingestion Rate for chemicals	IRagevss	57	mg-yr/kg-day	calculated
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Soil Ingestion Rate - adult	IRvss	50	mg/day	EPA et al. 2002
Soil Ingestion Rate - child	IRcvss	100	mg/day	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRa_agevss x EFvss x MLF) / [Atc_vss or Atnc][a] **where, IRa_agevss = (((Ira_vss x EDav) / BW) + ((IRa_cvss x EDcv) / BWc)) x ET**				
Chemical Intake	NRI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	EPC
Age-averaged Inhalation Rate for chemicals	IRa_agevss	3.7	m^3-yr/kg-day	EPA et al. 2002[b]
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Mass loading, (PM 10) for inhalation	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Air Inhalation Rate - adult	IRavss	2.4	m^3/hr	EPA et al. 2002
Air Inhalation Rate - child	IRa_cvss	1.6	m^3/hr	EPA et al. 2002
Exposure Time	Etvss	2.5	hr/day	EPA et al. 2002[b]
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated

Table 3.3
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Dermal Contact				
CI = (Cs x SFSagav x EFvss x ABS x EVv x CF_3) /[ATc_vss or ATnc] [a] **where, SFSagav = ((SAav x AFav xEDav) / BW) + ((SAcv x AFcv x EDcv) / BWc)**				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Adult skin-soil adherence factor	AFav	0.07	mg/cm^2-event	EPA 2001b[c]
Child skin-soil adherence factor	AFcv	0.2	mg/cm^2-event	EPA 2001b[d]
Adult skin surface area (exposed)	SAav	5700	cm^2	EPA 2001b[e]
Child skin surface area (exposed)	SAcv	2800	cm^2	EPA 2001b[f]
Age-averaged surface area/adherence factor	SFSagav	361	mg-yr/kg-event	EPA 2001b
Absorption Fraction	ABS	chemical-specific	[--]	EPA 2001b
Event frequency	EVv	1.00	events/day	EPA 2001
Conversion Factor	CF_3	0.000001	kg/mg	1 kg = 1.0E6 mg
Adult Body Weight	Bw	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated

[a] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[b] Value is the 50th percentile of time spent for open space users (Jefferson County 1996).

[c] The adult skin-soil adherence factor is the EPA residential default and the 50th percentile for gardeners. This is the value recommended by CDPHE for use in the WRW PRGs.

[d] The child skin-soil adherence factor is the EPA residential default and the 95th percentile for children playing in wet soil. This is the value recommended by CDPHE for use in the open space user PRGs.

[e] The adult skin-surface area value is the EPA default for residential exposures and the average of the 50th percentile for males and females > 18 years old wearing short-sleeved shirts, shorts, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

[f] The child skin-surface area value is the EPA default for residential exposures and the average of the 50th percentiles for males and females from <1 to <6 years old wearing short-sleeved shirts, shorts, and no shoes. The value was recommended by CDPHE for use in the WRW PRGs.

Table 4.1
Chemical Cancer Slope Factors, Weight of Evidence, and Target Organs for COCs

Contaminant of Concern	CAS Number	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Weight of Evidence[a]	Dermal Absorption Fraction[b]	Target Organ/Cancer	Source
Benzo(a)pyrene	50-32-8	7.3	I	7.3	O	0.31	P	B2	0.13	Tumors	A

[a] See Table 5.1 in the CRA Methodology (DOE 2004) for definitions of Weight of Evidence classifications.

[b] Dermal ABS from EPA 2001.

A = Agency for Toxic Substances and Disease Registry online database, http://www.atsdr.cdc.gov.
I = IRIS (EPA 2004a).
O = Oral slope factor used.
P = Provisional slope factor (NEEA).

Table 4.2
Chemical Non-Cancer Reference Doses, Target Organs, and Effects for COCs

Contaminant of Concern	CAS Number	Oral RfD (mg/kg-day)	Source	Dermal RfD (mg/kg-day)	Source	Inhalation RfD (mg/kg-day)	Source	Dermal Absorption Fraction[a]	Target Organ/Effect	Source
Benzo(a)pyrene	50-32-8	N/A	N/A	N/A	N/A	N/A	N/A	0.13	N/A	N/A

[a] Dermal ABS from EPA 2001.
N/A = Not available or not applicable.

Table 5.1
Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker

EPC/Medium/ Contaminant of Concern	Chemical Cancer Risk					Non-Cancer Hazard Quotient				
	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Risk	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Hazard Index
Tier 1										
Surface Soil/Surface Sediment										
Benzo(a)pyrene	9.50E-07	2.39E-10	4.77E-07	1.43E-06	100%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**1E-06**	**100%**				**NC**	**NC**
Tier 1 WRW Total:				**1E-06**					**NC**	
Tier 2										
Surface Soil/Surface Sediment										
Benzo(a)pyrene	6.83E-07	1.72E-10	3.43E-07	1.03E-06	100%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**1E-06**	**100%**				**NC**	**NC**
Tier 2 WRW Total:				**1E-06**					**NC**	

NC = Not calculated, noncancer toxicity criteria were not available.

Table 5.2
Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor

EPC/Medium/ Contaminant of Concern	Chemical Cancer Risk					Non-Cancer Hazard Quotient				
	Ingestion	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Percent Contribution to Risk**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Percent Contribution to Hazard Index**
Tier 1										
Surface Soil/Surface Sediment										
Benzo(a)pyrene	8.84E-07	1.61E-10	7.26E-07	1.61E-06	100%	NC	NC	NC	NC	NC
			Surface Soil/Surface Sediment Total:	**2E-06**	**100%**				**NC**	**NC**
			Tier 1 WRV Total:	**2E-06**					**NC**	
Tier 2										
Surface Soil/Surface Sediment										
Benzo(a)pyrene	6.35E-07	1.16E-10	5.22E-07	1.16E-06	100%	NC	NC	NC	NC	NC
			Surface Soil/Surface Sediment Total:	**1E-06**	**100%**				**NC**	**NC**
			Tier 2 WRV Total:	**1E-06**					**NC**	

NC = Not calculated, noncancer toxicity criteria were not available.

Table 5.3
Summary of Risk Characterization Results

Exposure Scenario/EPC/Medium	Estimated Excess Lifetime Cancer Risk	Major Contributors to Chemical Cancer Risk	Estimated Non-Cancer Hazard Quotient	Major Contributors to Hazard Quotient
Wildlife Refuge Worker (WRW)				
Tier 1 EPC				
Surface Soil/Surface Sediment	1E-06	Benzo(a)pyrene (100%)	NC	N/A
Tier 2 EPC				
Surface Soil/Surface Sediment	1E-06	Benzo(a)pyrene (100%)	NC	N/A
Wildlife Refuge Visitor (WRV)				
Tier 1 EPC				
Surface Soil/Surface Sediment	2E-06	Benzo(a)pyrene (100%)	NC	N/A
Tier 2 EPC				
Surface Soil/Surface Sediment	1E-06	Benzo(a)pyrene (100%)	NC	N/A

NC = Not calculated, noncancer toxicity criteria were not available.
N/A = Not applicable.

Table 6.1
Detected PCOCs without PRGs in Each Medium by Analyte Suite[a]

Analyte	Surface Soil/Surface Sediment	Subsurface Soil/Subsurface Sediment
Cations/Anions		
Chloride	X	N/A
Inorganics		
Cesium	X	X
Silica	X[b]	X
Silicon	X[b]	X[b]
Sulfide	N/A	X
Organics		
1,2,3-Trichlorobenzene	N/A	X[b]
2-Hexanone	N/A	X
Benzo(g,h,i)perylene	X	X
n-Butylbenzene	N/A	X[b]
Phenanthrene	X	X
Radionuclides		
Gross alpha	X	X
Gross beta	X	X

[a] Does not include essential nutrients or dioxin/furan congeners. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes. Dioxin and furan congeners were evaluated by calculating the TCDD Equivalents (TEQ), which are presented in Table 1.8.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

N/A = Not applicable. Analyte not detected or not analyzed.
X = PRG is unavailable.

Table 7.1

Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates, and Vertebrates in the UWNEU

Analyte	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																													
Aluminum	24,100	50	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plants	**Yes**
Antimony	43.6	5	**Yes**	78	No	N/A	N/A	N/A	N/A	N/A	N/A	9.89	**Yes**	0.905	**Yes**	18.7	**Yes**	57.6	No	138	No	13.2	**Yes**	3.85	**Yes**	N/A	N/A	Deer Mouse Insectivore	**Yes**
Arsenic	9.6	10	No	60	No	20	No	164	No	1,030	No	2.57	**Yes**	51.4	No	9.35	**Yes**	13	No	709	No	341	No	293	No	N/A	N/A	Deer Mouse Herbivore	**Yes**
Barium	272	500	No	330	No	159	**Yes**	357	No	1,320	No	930	No	4,430	No	3,220	No	4,770	No	24,900	No	19,800	No	18,400	No	N/A	N/A	Mourning Dove Herbivore	**Yes**
Beryllium	1.5	10	No	40	No	N/A	N/A	N/A	N/A	N/A	N/A	160	No	6.82	No	211	No	896	No	1,070	No	103	No	29.2	No	N/A	N/A	Deer Mouse Insectivore	No
Boron	10.4	0.5	**Yes**	N/A	N/A	30.3	No	115	No	167	No	62.1	No	422	No	237	No	314	No	929	No	6,070	No	1,820	No	N/A	N/A	Terrestrial Plants	**Yes**
Cadmium	2.7	32	No	140	No	28.1	No	0.705	**Yes**	15	No	59.9	No	1.56	**Yes**	198	No	723	No	1,360	No	51.2	No	9.75	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Calcium	92,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium	7.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chromium[b]	31.1	1	**Yes**	0.4	**Yes**	24.6	**Yes**	1.34	**Yes**	14	**Yes**	281	No	15.9	**Yes**	703	No	1,460	No	4,170	No	250	No	68.5	No	N/A	N/A	Terrestrial Invertebrates	**Yes**
Cobalt	18.8	13	**Yes**	N/A	N/A	278	No	87	No	440	No	1,480	No	363	No	2,460	No	7,900	No	3,780	No	2,490	No	1,520	No	N/A	N/A	Terrestrial Plants	**Yes**
Copper	61.6	100	No	50	**Yes**	28.9	**Yes**	8.25	**Yes**	164	No	295	No	605	No	838	No	4,120	No	5,460	No	3,000	No	4,640	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Iron	34,600	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Lead	62	110	No	1,700	No	49.9	**Yes**	12.1	**Yes**	95.8	No	1,340	No	242	No	1,850	No	9,800	No	8,930	No	3,070	No	1,390	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Lithium	14.2	2	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,880	No	610	No	3,180	No	10,200	No	18,400	No	5,610	No	2,560	No	N/A	N/A	Terrestrial Plants	**Yes**
Magnesium	12,200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Manganese	823	500	**Yes**	N/A	N/A	1030	No	2,630	No	9,920	No	486	**Yes**	4,080	No	1,519	No	2,510	No	14,100	No	10,900	No	19,100	No	N/A	N/A	Deer Mouse Herbivore	**Yes**
Mercury	0.21	0.3	No	0.1	**Yes**	0.197	**Yes**	0.0001	**Yes**	1.57	No	0.439	No	0.179	**Yes**	3.15	No	7.56	No	8.18	No	8.49	No	37.3	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Molybdenum	19.1	2	**Yes**	N/A	N/A	44.4	No	6.97	**Yes**	76.7	No	8.68	**Yes**	1.9	**Yes**	27.1	No	44.3	No	275	No	28.9	No	8.18	**Yes**	N/A	N/A	Deer Mouse Insectivore	**Yes**
Nickel	28.3	30	No	200	No	44.1	No	1.24	**Yes**	13.1	**Yes**	16.4	**Yes**	0.431	**Yes**	38.3	No	124	No	90.9	No	6.02	**Yes**	1.86	**Yes**	N/A	N/A	Deer Mouse Insectivore	**Yes**
Nitrate / Nitrite	6.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,480	No	7,650	No	16,200	No	22,700	No	32,900	No	32,200	No	32,900	No	N/A	N/A	Deer Mouse Herbivore	No
Potassium	4,430	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Selenium	0.79	1	No	70	No	1.61	No	1	No	8.48	No	0.872	No	0.754	**Yes**	2.8	No	3.82	No	32.5	No	12.2	No	5.39	No	N/A	N/A	Deer Mouse Insectivore	**Yes**
Silica	930	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silicon	4,570	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silver	8.9	2	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plants	**Yes**
Sodium	1,650	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Strontium	255	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	940	No	13,600	No	3,520	No	4,700	No	584,000	No	145,000	No	57,300	No	N/A	N/A	Deer Mouse Herbivore	No
Thallium	1.2	1	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	180	No	7.24	No	204	No	1,040	No	212	No	81.6	No	30.8	No	N/A	N/A	Terrestrial Plants	**Yes**
Tin	33.8	50	No	N/A	N/A	26.1	**Yes**	2.9	**Yes**	19	**Yes**	45	No	3.77	**Yes**	80.6	No	242	No	70	No	36.1	No	16.2	**Yes**	N/A	N/A	Mourning Dove Insectivore	**Yes**
Titanium	844	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Vanadium	75.9	2	**Yes**	N/A	N/A	503	No	274	No	1,510	No	63.7	**Yes**	29.9	**Yes**	83.5	No	358	No	341	No	164	No	121	No	N/A	N/A	Terrestrial Plants	**Yes**
Zinc	120	50	**Yes**	200	No	109	**Yes**	0.646	**Yes**	113	**Yes**	171	No	5.29	**Yes**	1,170	No	2,770	No	16,500	No	3,890	No	431	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Organics (µg/kg)																													
Acetone	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	67,500	No	6,180	No	248,000	No	341,000	No	23,200	No	24,000	No	26,800	No	N/A	N/A	Deer Mouse Insectivore	No
Benzo(a)anthracene	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(a)pyrene	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	337,000	No	631	No	503,000	No	2,410,000	No	3,060	No	2,970	No	2,760	No	N/A	N/A	Deer Mouse Insectivore	No
Benzo(b)fluoranthene	94	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(g,h,i)perylene	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(k)fluoranthene	110	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzoic Acid	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
bis(2-ethylhexyl)phthalate	3,600	N/A	N/A	N/A	N/A	19500	No	137	**Yes**	398	**Yes**	960,000	No	8070	No	2,760,000	No	4,930,000	No	42,300	No	40,200	No	35,000	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Butylbenzylphthalate	220	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,000,000	No	24200	No	3,370,000	No	5,080,000	No	110,000	No	109,000	No	105,000	No	N/A	N/A	Deer Mouse Insectivore	No
Chrysene	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Di-n-butylphthalate	79	200,000	No	N/A	N/A	989	No	15.9	**Yes**	41.5	**Yes**	12,100,000	No	281,000	No	40,600,000	No	61,300,000	No	1,290,000	No	1,270,000	No	1,220,000	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Di-n-octylphthalate	570	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	90,500,000	No	731,000	No	258,000,000	No	465,000,000	No	3,850,000	No	3,650,000	No	3,170,000	No	N/A	N/A	Deer Mouse Insectivore	No
Fluoranthene	110	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Indeno(1,2,3-cd)pyrene	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Methylene Chloride	34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	58,200	No	3400	No	210,000	No	295,000	No	13,700	No	13,900	No	14,700	No	N/A	N/A	Deer Mouse Insectivore	No
Phenanthrene	73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Pyrene	93	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Tetrachloroethene	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20,700	No	763	No	72,500	No	105,000	No	3,280	No	3,290	No	3,310	No	N/A	N/A	Deer Mouse Insectivore	No
Toluene	130	200,000	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	347,000	No	14,400	No	1,220,000	No	1,760,000	No	61,000	No	61,300	No	62,500	No	N/A	N/A	Deer Mouse Insectivore	No
Total PCBs	270	40,000	No	N/A	N/A	1140	No	**172**	**Yes**	886	No	11,900	No	1,240	No	38,000	No	61,300	No	5190	No	3,320	No	3,680	No	N/A	N/A	Mourning Dove Insectivore	**Yes**
Trichloroethene	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9,170	No	389	No	32,400	No	46,500	No	1,640	No	1,650	No	1,690	No	N/A	N/A	Deer Mouse Insectivore	No
Trichlorofluoromethane	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Radionuclides (pCi/g)																													
Americium-241	4.48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,890	No	N/A	No
Cesium-134	0.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium-137	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.8	No	N/A	No
Gross Alpha	36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Beta	71.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-239/240	10.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,110	No	N/A	No
Radium-226	1.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	50.6	No	N/A	No
Radium-228	1.737	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	43.9	No	N/A	No
Strontium-89/90	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22.5	No	N/A	No
Uranium-233/234	2.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,980	No	N/A	No
Uranium-235	0.232	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,770	No	N/A	No
Uranium-238	1.83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,580	No	N/A	No

[a] Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological specie

[b] The ESLs for chromium were developed based on available toxicity data and are based on chromium III (birds) and chromium (VI) (plants, invertebrates, and mammal

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Table 7.2
Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWNEU

Analyte	Terrestrial Plant Exceedance?	Terrestrial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics			
Aluminum	**Yes**	UT	UT
Antimony	**Yes**	No	**Yes**
Arsenic	No	No	**Yes**
Barium	No	No	**Yes**
Beryllium	No	No	No
Boron	**Yes**	UT	No
Cadmium	No	No	**Yes**
Calcium	UT	UT	UT
Cesium	UT	UT	UT
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	**Yes**	UT	No
Copper	No	**Yes**	**Yes**
Iron	UT	UT	UT
Lead	No	No	**Yes**
Lithium	**Yes**	UT	No
Magnesium	UT	UT	UT
Manganese	**Yes**	UT	**Yes**
Mercury	No	**Yes**	**Yes**
Molybdenum	**Yes**	UT	**Yes**
Nickel	No	No	**Yes**
Nitrate / Nitrite	UT	UT	No
Potassium	UT	UT	UT
Selenium	No	No	**Yes**
Silica	UT	UT	UT
Silicon	UT	UT	UT
Silver	**Yes**	UT	UT
Sodium	UT	UT	UT
Strontium	UT	UT	No
Thallium	**Yes**	UT	No
Tin	No	UT	**Yes**
Titanium	UT	UT	UT
Vanadium	**Yes**	UT	**Yes**
Zinc	**Yes**	No	**Yes**
Organics			
Acetone	UT	UT	No
Benzo(a)anthracene	UT	UT	UT
Benzo(a)pyrene	UT	UT	No
Benzo(b)fluoranthene	UT	UT	UT
Benzo(g,h,i)perylene	UT	UT	UT
Benzo(k)fluoranthene	UT	UT	UT
Benzoic Acid	UT	UT	UT
bis(2-ethylhexyl)phthalate	UT	UT	**Yes**
Butylbenzylphthalate	UT	UT	No
Chrysene	UT	UT	UT
Di-n-butylphthalate	No	UT	**Yes**
Di-n-octylphthalate	UT	UT	No
Fluoranthene	UT	UT	UT
Indeno(1,2,3-cd)pyrene	UT	UT	UT
Methylene Chloride	UT	UT	No
Phenanthrene	UT	UT	UT
Pyrene	UT	UT	UT
Tetrachloroethene	UT	UT	No
Toluene	No	UT	No
Total PCBs	No	UT	**Yes**
Trichloroethene	UT	UT	No
Trichlorofluoromethane	UT	UT	UT
Radionuclides			
Americium-241	UT	UT	No
Cesium-134	UT	UT	UT

Table 7.2
Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWNEU

Analyte	Terrestrial Plant Exceedance?	Terrestrial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Cesium-137	UT	UT	No
Gross Alpha	UT	UT	UT
Gross Beta	UT	UT	UT
Plutonium-239/240	UT	UT	No
Radium-226	UT	UT	No
Radium-228	UT	UT	No
Strontium-89/90	UT	UT	No
Uranium-233/234	UT	UT	No
Uranium-235	UT	UT	No
Uranium-238	UT	UT	No

UT - Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.3
Comparison of MDCs in Surface Soil with NOAEL ESLs for the PMJM in the UWNEU

Analyte	MDC	PMJM NOAEL ESL	EPC> PMJM ESL?
Inorganics (mg/kg)			
Aluminum	21,600	N/A	UT
Antimony	26.5	1	**Yes**
Arsenic	7.8	2.21	**Yes**
Barium	231	743	No
Beryllium	1.2	8.16	No
Boron	9.6	52.7	No
Cadmium	2.7	1.75	**Yes**
Calcium	161,000	N/A	UT
Cesium	6.1	N/A	UT
Chromium[a]	20.6	19.3	**Yes**
Cobalt	18.8	340	No
Copper	61.6	95.0	No
Iron	34,600	N/A	UT
Lead	62	220	No
Lithium	16.7	519	No
Magnesium	11,400	N/A	UT
Manganese	823	388	**Yes**
Mercury	0.34	0.052	**Yes**
Molybdenum	0.9	1.84	No
Nickel	25	0.51	**Yes**
Nitrate / Nitrite	6.62	2,910	No
Potassium	4,520	N/A	UT
Selenium	0.7	0.421	**Yes**
Silica	930	N/A	UT
Silicon	4,570	N/A	UT
Silver	52.7	N/A	UT
Sodium	1,650	N/A	UT
Strontium	151	833	No
Thallium	1.2	8.64	No
Tin	29.7	4	**Yes**
Titanium	242	N/A	UT
Vanadium	75.9	21.6	**Yes**
Zinc	650	6.41	**Yes**
Organics (µg/kg)			
Acetone	61	6,998.6	No
Benzo(a)anthracene	210	N/A	UT
Benzo(k)fluoranthene	220	N/A	UT
Benzoic acid	200	N/A	UT
bis(2-ethylhexyl)phthalate	1,100	10,166.0	No
Butylbenzylphthalate	140	29,800.0	No
Di-n-butylphthalate	79	347,225	No
Di-n-octylphthalate	570	921,605	No
Fluoranthene	590	N/A	UT
Indeno(1,2,3-cd)pyrene	140	N/A	UT
Methylene chloride	34	4,010.6	No
Pyrene	440	N/A	UT
Tetrachloroethene	3	925.78	No
Toluene	130	17,377.43	No
Total PCBs	270	1,349.8	No
Trichloroethene	2	468.63	No
Radionuclides (pCi/kg)			
Americium-241	4.5	3,890	No
Cesium-134	0.12	N/A	UT
Cesium-137	0.68	20.8	No
Gross Alpha	28	N/A	UT
Gross Beta	71.7	N/A	UT
Plutonium-239/240	10.4	6,110	No
Radium-226	1.08	50.6	No
Radium-228	1.4	43.9	No
Strontium-89/90	0.25	22.5	No
Uranium-233/234	2.8	4,980	No
Uranium-235	0.216	2,770	No
Uranium-238	1.83	1,580	No

[a] Chromium ESL is based on Chromium VI.

UT = Uncertain toxicity; no ESLs available (assessed in Section 10).

N/A = No ESL available for the ECOI/receptor pair.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.4
Statistical Distribution and Comparison to Background for Surface Soil in the UWNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics (mg/kg)									
Aluminum	20	NORMAL	100	90	GAMMA	100	WRS	0.034	**Yes**
Antimony	20	NON-PARAMETRIC	0	84	NON-PARAMETRIC	44	N/A	N/A	**Yes**[a]
Arsenic	20	NORMAL	100	90	NORMAL	100	t-Test_N	0.994	No
Barium	20	NORMAL	100	90	NORMAL	100	t-Test_N	3.23E-05	**Yes**
Boron	N/A	N/A	N/A	13	NORMAL	100	N/A	N/A	**Yes**[a]
Cadmium	20	NON-PARAMETRIC	65	90	NON-PARAMETRIC	34	WRS	0.914	No
Chromium	20	NORMAL	100	90	NORMAL	87	t-Test_N	0.183	No
Cobalt	20	NORMAL	100	90	NON-PARAMETRIC	98	WRS	0.034	**Yes**
Copper	20	NON-PARAMETRIC	100	90	NON-PARAMETRIC	99	WRS	9.40E-06	**Yes**
Lead	20	NORMAL	100	90	GAMMA	100	WRS	1.000	No
Lithium	20	NORMAL	100	86	GAMMA	74	WRS	0.372	No
Manganese	20	NORMAL	100	90	NON-PARAMETRIC	100	WRS	0.407	No
Mercury	20	NON-PARAMETRIC	40	86	NON-PARAMETRIC	37	WRS	1.000	No
Molybdenum	20	NORMAL	0	87	NON-PARAMETRIC	17	N/A	N/A	**Yes**[a]
Nickel	20	NORMAL	100	90	NORMAL	98	t-Test_N	1.18E-05	**Yes**
Selenium	20	NON-PARAMETRIC	60	90	NON-PARAMETRIC	17	N/A	N/A	**Yes**[a]
Silver	20	NORMAL	0	88	NON-PARAMETRIC	20	N/A	N/A	**Yes**[a]
Thallium	14	NORMAL	0	88	NON-PARAMETRIC	35	N/A	N/A	**Yes**[a]
Tin	20	NORMAL	0	87	NON-PARAMETRIC	7	N/A	N/A	**Yes**[a]
Vanadium	20	NORMAL	100	90	GAMMA	100	WRS	4.87E-04	**Yes**
Zinc	20	NORMAL	100	90	GAMMA	100	WRS	0.001	**Yes**

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
WRS = Wilcoxon Rank Sum.
t-Test_N = Students t-test using normal data.
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.5
Statistical Distributions and Comparison to Background for Surface Soil in PMJM Habitat in the UWNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics									
Antimony	20	NON-PARAMETRIC	0	61	NON-PARAMETRIC	34	N/A	N/A	**Yes**[a]
Arsenic	20	NORMAL	100	62	NORMAL	100	t-Test_N	0.995	No
Cadmium	20	NON-PARAMETRIC	65	62	NON-PARAMETRIC	42	WRS	0.786	No
Chromium	20	NORMAL	100	62	NORMAL	100	t-Test_N	0.367	No
Manganese	20	NORMAL	100	62	NON-PARAMETRIC	100	WRS	0.500	No
Mercury	20	NON-PARAMETRIC	40	61	NON-PARAMETRIC	25	WRS	1.000	No
Nickel	20	NORMAL	100	62	NORMAL	100	t-Test_N	8.91E-07	**Yes**
Selenium	20	NON-PARAMETRIC	60	62	NON-PARAMETRIC	11	N/A	N/A	**Yes**[a]
Tin	20	NORMAL	0	61	NON-PARAMETRIC	18	N/A	N/A	**Yes**[a]
Vanadium	20	NORMAL	100	62	NON-PARAMETRIC	100	WRS	0.013	**Yes**
Zinc	20	NORMAL	100	62	NON-PARAMETRIC	100	WRS	6.05E-05	**Yes**

[a] Statistical comparisons to background cannot be performed. The analyte is retained for further evaluation.
N/A = Not applicable; site and/or background detection frequency less than 20%.
t-Test_N = Student's t-test using normal data
WRS = Wilcoxon Rank Sum.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.6
Statistical Concentrations in Surface Soil in the UWNEU[a]

Analyte	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th Percentile	95th Percentile	UCL	UTL	MDC
Inorganics (mg/kg)										
Aluminum	90	95% Approximate Gamma UCL	GAMMA	12,192	11,150	14,850	19,710	12,932	19,600	24,100
Antimony	84	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	10.8	6.78	17.6	30.0	17.5	30.2	43.6
Barium	90	95% Student's-t UCL	NORMAL	148	146	175	239	157	222	272
Boron	13	95% Student's-t UCL	NORMAL	4.74	3.90	5.90	8.54	5.95	10.0	10.4
Cobalt	90	95% Student's-t UCL	NON-PARAMETRIC	8.41	8.00	9.40	12.7	8.89	12.0	18.8
Copper	90	95% Student's-t UCL	NON-PARAMETRIC	18.8	17.1	20.0	34.6	20.3	31.7	61.6
Molybdenum	87	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	1.92	1.95	2.05	2.80	2.86	2.80	19.1
Nickel	90	95% Student's-t UCL	NORMAL	13.8	14.1	16.0	20.8	14.5	20.1	28.3
Selenium	90	95% Student's-t UCL	NON-PARAMETRIC	0.296	0.225	0.300	0.561	0.319	0.550	0.790
Silver	88	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.899	0.650	1.16	2.40	1.42	2.50	8.90
Thallium	88	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.279	0.240	0.390	0.563	0.373	0.570	1.20
Tin	87	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	8.69	9.50	9.73	24.1	11.8	26.4	33.8
Vanadium	90	95% Approximate Gamma UCL	GAMMA	35.7	34.3	40.0	54.9	37.7	50.9	75.9
Zinc	90	95% Approximate Gamma UCL	GAMMA	60.2	61.3	67.3	84.7	63.0	84.3	120
Organics (µg/kg)										
bis(2-ethylhexyl)phthalate	17	99% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	421	210	230	1,600	2,480	3,600	3,600
Di-n-butylphthalate	17	95% Student's-t UCL	NON-PARAMETRIC	198	220	225	240	221	240	240
Total PCBs	44	95% Student's-t UCL	NON-PARAMETRIC	175.3	170.0	203	229	185	230	270

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the statistical concentrations.
MDC = Maximum detected concentration or in some cases, maximum proxy result.
UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.
UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

Table 7.7
Upper-Bound Exposure Point Concentration Comparison to Limiting ESLs for Surface Soil in the UWNEU

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (UTL)	Limiting ESL[a]	EPC>ESL?	EPC (UCL)	Limiting ESL[b]	EPC>ESL?
Inorganics (mg/kg)						
Aluminum	19,600	50	**Yes**	12,932	N/A	N/A
Antimony	30.2	0.905	**Yes**	17.5	3.85	**Yes**
Barium	222	222	No	157	4,770	No
Boron	10	0.5	**Yes**	5.95	314	No
Cobalt	12	13	No	8.89	1,520	No
Copper	31.7	8.25	**Yes**	20.3	3,000	No
Molybdenum	2.8	1.9	**Yes**	2.86	8.18	No
Nickel	20.1	0.431	**Yes**	14.5	1.86	**Yes**
Selenium	0.55	0.754	No	0.319	3.82	No
Silver	2.5	2	**Yes**	1.42	N/A	N/A
Thallium	0.57	1	No	0.373	53.3	No
Tin	26.4	2.9	**Yes**	11.8	16.2	No
Vanadium	50.9	2	**Yes**	37.7	121	No
Zinc	84.3	0.646	**Yes**	63	431	No
Organics (µg/kg)						
Bis(2-ethylhexyl)phthalate	3,600	137	**Yes**	2,480	35,000	No
Di-n-butylphthalate	240	15.9	**Yes**	221	122,000	No
Total PCBs	230	172	**Yes**	185	1,180	No

[a]Lowest ESL (threshold if available) for the plant, invertebrate, deer mouse, prairie dog, dove, or kestrel receptors.

[b]Lowest ESL (threshold if available) for the coyote and mule deer receptors.

N/A = Not applicable; ESL not available (assessed in Section 10.0).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.8
Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home-Range Receptors in the UWNEU

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Aluminum	19,600	**50**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	30.2	**5**	78	N/A	N/A	N/A	**9.89**	**0.905**	**18.7**
Boron	10	**0.5**	N/A	167	30.3	115	62.1	422	237
Copper	31.7	100	50.0	164	**28.8**	**8.25**	295	605	838
Molybdenum	2.8	**2**	N/A	76.1	44.1	6.97	8.68	**1.9**	27.1
Nickel	20.1	30	200	89.9	320	**7.84**	**16.4**	**0.431**	38.3
Silver	2.5	**2**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tin	33.8	50	N/A	**19**	**26.1**	**2.9**	45	**3.77**	80.6
Vanadium	75.9	**2**	N/A	1,510	503	274	**63.7**	**29.9**	83.5
Zinc	120	**50**	200	**113**	**109**	**0.646**	171	**5.29**	1,170
Organics (µg/kg)									
Bis(2-ethylhexyl)phthalate	3,600	200,000	N/A	**398**	19,500	**137**	96,200	8,070	27,600
Di-n-butylpthalate	240	N/A	N/A	**41.5**	989	**15.9**	1.21E+06	281,000	4.06E+06
PCB (Total)	230	40,000	N/A	886	1,140	**172**	17,000	16,100	53,200

[a]Lowest ESL (threshold if available) for that receptor.
N/A = Not applicable; ESL not available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.9

Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Large Home-Range Receptors in the UWNEU

Analyte	Large Home Range Receptor UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Antimony	17.50	58	138	**13**	**3.9**
Nickel	14.5	124	91	**6.0**	**1.9**

[a]Lowest ESL (threshold if available) for that receptor.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.10
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWNEU

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[a]	Upper-Bound EPC > Limiting ESL?	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Aluminum	Yes	Yes	Yes	Yes	No	No	--
Antimony	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Terrestrial plant Deer Mouse (herbivore) Deer mouse (insectivore) Prairie dog Coyote (generalist) Coyote (insectivore)**
Arsenic	Yes	Yes	No	--	--	No	--
Barium	Yes	Yes	Yes	No	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	Yes	Yes	N/A	Yes	No	No	--
Cadmium	Yes	Yes	No	--	--	No	--
Calcium	UT	--	--	--	--	No	--
Cesium	UT	--	--	--	--	No	--
Chromium	Yes	Yes	No	--	--	No	--
Cobalt	Yes	Yes	Yes	No	--	No	--
Copper	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (herbivore) Mourning dove (insectivore)**
Iron	UT	--	--	--	--	No	--
Lead	Yes	Yes	No	--	--	No	--
Lithium	Yes	Yes	No	--	--	No	--
Magnesium	UT	--	--	--	--	No	--
Manganese	Yes	Yes	No	--	--	No	--
Mercury	Yes	Yes	No	--	--	No	--
Molybdenum	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant Deer mouse (insectivore)**
Nickel	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)**
Nitrate / Nitrite	No	--	--	--	--	No	--
Potassium	UT	--	--	--	--	No	--
Selenium	Yes	Yes	Yes	No	--	No	--
Silica	UT	--	--	--	--	No	--
Silicon	UT	--	--	--	--	No	--
Silver	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant**
Sodium	UT	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--

Table 7.10
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWNEU

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[a]	Upper-Bound EPC > Limiting ESL?	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Thallium	Yes	Yes	N/A	No	--	No	--
Tin	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel Mourning dove (herbivore) Mourning dove (insectivore) Deer mouse (insectivore)**
Titanium	UT	--	--	--	--	No	--
Uranium	No	--	--	--	--	No	--
Vanadium	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Terrestrial plant Deer Mouse (herbivore) Deer mouse (insectivore)**
Zinc	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Terrestrial plant American kestrel Mourning dove (herbivore) Mourning dove (insectivore) Deer mouse (insectivore)**
Organics							
1,2,4-Trimethylbenzene	UT	--	--	--	--	No	--
Acetone	No	--	--	--	--	No	--
Benzo(a)anthracene	UT	--	--	--	--	No	--
Benzo(a)pyrene	No	--	--	--	--	No	--
Benzo(b)fluoranthene	UT	--	--	--	--	No	--
Benzo(g,h,i)perylene	UT	--	--	--	--	No	--
Benzo(k)fluoranthene	UT	--	--	--	--	No	--
Benzoic Acid	UT	--	--	--	--	No	--
bis(2-ethylhexyl)phthalate	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel Mourning dove (insectivore)**
Butylbenzylphthalate	No	--	--	--	--	No	--
Chrysene	UT	--	--	--	--	No	--
Di-n-butylphthalate	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel Mourning dove (insectivore)**
Di-n-octylphthalate	No	--	--	--	--	No	--
Ethylbenzene	UT	--	--	--	--	No	--
Fluoranthene	UT	--	--	--	--	No	--
Indeno(1,2,3-cd)pyrene	UT	--	--	--	--	No	--
Isopropylbenzene	UT	--	--	--	--	No	--
Methylene Chloride	No	--	--	--	--	No	--
Phenanthrene	UT	--	--	--	--	No	--
Pyrene	UT	--	--	--	--	No	--
Tetrachloroethene	No	--	--	--	--	No	--
Toluene	No	--	--	--	--	No	--

Table 7.10
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWNEU

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[a]	Upper-Bound EPC > Limiting ESL?	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Total PCBs	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Mourning dove (insectivore)**
Trichloroethene	No	--	--	--	--	No	--
Trichlorofluoromethane	N/A	--	--	--	--	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Cesium-134	UT	--	--	--	--	No	--
Cesium-137	No	--	--	--	--	No	--
Gross Alpha	UT	--	--	--	--	No	--
Gross Beta	UT	--	--	--	--	No	--
Plutonium-239/240	No	--	--	--	--	No	--
Radium-226	No	--	--	--	--	No	--
Radium-228	No	--	--	--	--	No	--
Strontium-89/90	No	--	--	--	--	No	--
Uranium-233/234	No	--	--	--	--	No	--
Uranium-235	No	--	--	--	--	No	--
Uranium-238	No	--	--	--	--	No	--

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.

N/A = Not applicable; background comparison could not be conducted.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Chemicals retained as ECOPCs for further risk characterization.

Table 7.11
Summary of ECOPC Screening Steps for Surface Soil PMJM Receptors in the UWNEU

Analyte	Exceed PMJM NOAEL ESL?	Exceeds Background?	Professional Judgment - Retain?	ECOPC?
Inorganics				
Aluminum	UT	--	--	No
Antimony	**Yes**	**Yes**	**Yes**	**Yes**
Arsenic	Yes	No	--	No
Barium	No	--	--	No
Beryllium	No	--	--	No
Boron	No	--	--	No
Cadmium	Yes	No	--	No
Calcium	UT	--	--	No
Cesium	UT	--	--	No
Chromium	Yes	No	--	No
Cobalt	No	--	--	No
Copper	No	--	--	No
Iron	UT	--	--	No
Lead	No	--	--	No
Lithium	No	--	--	No
Magnesium	UT	--	--	No
Manganese	Yes	No	--	No
Mercury	Yes	No	--	No
Molybdenum	No	--	--	No
Nickel	**Yes**	**Yes**	**Yes**	**Yes**
Nitrate / Nitrite	No	--	--	No
Potassium	UT	--	--	No
Selenium	Yes	Yes	No	No
Silica	UT	--	--	No
Silicon	UT	--	--	No
Silver	UT	--	--	No
Sodium	UT	--	--	No
Strontium	No	--	--	No
Thallium	No	--	--	No
Tin	**Yes**	**Yes**	**Yes**	**Yes**
Titanium	UT	--	--	No
Vanadium	**Yes**	**Yes**	**Yes**	**Yes**
Zinc	**Yes**	**Yes**	**Yes**	**Yes**
Organics				
4,4'-DDE	No	--	--	No
Acenaphthene	UT	--	--	No
Acetone	No	--	--	No
Anthracene	UT	--	--	No
Benzo(a)anthracene	UT	--	--	No
Benzo(a)pyrene	No	--	--	No
Benzo(b)fluoranthene	UT	--	--	No
Benzo(g,h,i)perylene	UT	--	--	No
Benzo(k)fluoranthene	UT	--	--	No
Benzoic acid	UT	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	No
Butylbenzylphthalate	No	--	--	No
Chrysene	UT	--	--	No
Dibenz(a,h)anthracene	UT	--	--	No
Di-n-butylphthalate	No	--	--	No
Di-n-octylphthalate	No	--	--	No
Endrin	No	--	--	No
Fluoranthene	UT	--	--	No
Fluorene	UT	--	--	No
Indeno(1,2,3-cd)pyrene	UT	--	--	No
Methoxychlor	No	--	--	No
Methylene chloride	No	--	--	No

Table 7.11
Summary of ECOPC Screening Steps for Surface Soil PMJM Receptors in the UWNEU

Analyte	Exceed PMJM NOAEL ESL?	Exceeds Background?	Professional Judgment - Retain?	ECOPC?
Total PCBs	No	--	--	No
Pyrene	UT	--	--	No
Tetrachloroethene	No	--	--	No
Toluene	No	--	--	No
Trichloroethene	No	--	--	No
Radionuclides				
Americium-241	No	--	--	No
Cesium-134	UT	--	--	No
Cesium-137	No	--	--	No
Gross Alpha	UT	--	--	No
Gross Beta	UT	--	--	No
Plutonium-239/240	No	--	--	No
Radium-226	No	--	--	No
Radium-228	No	--	--	No
Strontium-89/90	No	--	--	No
Uranium-233/234	No	--	--	No
Uranium-235	No	--	--	No
Uranium-238	No	--	--	No

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.12
Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWNEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Inorganics (mg/kg)			
Aluminum	42,500	N/A	UT
Antimony	18.6	18.7	No
Arsenic	15.1	9.35	**Yes**
Barium	783	3,220	No
Beryllium	2.1	211	No
Boron	8.8	237	No
Cadmium	2.3	198	No
Calcium	203,000	N/A	UT
Cesium	6.8	N/A	UT
Chromium [a]	32.5	703	No
Cobalt	55	2,460	No
Copper	34.1	838	No
Iron	110,000	N/A	UT
Lead	84.9	1,850	No
Lithium	30.6	3,180	No
Magnesium	6,090	N/A	UT
Manganese	1,400	1,519	No
Mercury	0.27	3.15	No
Molybdenum	6.3	27.1	No
Nickel	190	38.3	**Yes**
Nitrate / Nitrite	25.1	16,200	No
Potassium	3,660	N/A	UT
Selenium	5.8	2.8	**Yes**
Silica	1,300	N/A	UT
Silicon	3,590	N/A	UT
Silver	7.7	N/A	UT
Sodium	860	N/A	UT
Strontium	506	3,520	No
Thallium	0.63	204	No
Tin	52.2	80.6	No
Titanium	286	N/A	UT
Uranium	5.7	1,230	No
Vanadium	73.9	83.5	No
Zinc	706	1,170	No
Organics (μg/kg)			
1,1,1-Trichloroethane	6	48,500,000	No
1,1-Dichloroethene	3	1,280,000	No
1,2,3-Trichlorobenzene	1.2	N/A	UT
1,2,4-Trichlorobenzene	1	94,500	No
1,2,4-Trimethylbenzene	0.19	N/A	UT
1,2-Dichloroethene	11	1,870,000	No
Total Dioxins	0.022	0.116	No
2-Butanone	3,700	49,400,000	No
2-Hexanone	0.82	N/A	UT
4-Methyl-2-pentanone	21	859,000	No
Acetone	5,100	248,000	No
Benzo(a)anthracene	84	N/A	UT
bis(2-ethylhexyl)phthalate	490	2,760,000	No
Carbon Disulfide	7.2	411,000	No
Carbon Tetrachloride	110	736,000	No
Chlorobenzene	74	414,000	No
Chloroform	84	560,000	No
Chrysene	79	N/A	UT
Heptachlorodibenzo-p-dioxin	0.00156	N/A	UT

Table 7.12
Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWNEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Methylene Chloride	190	210,000	No
N/Aphthalene	1.5	16,000,000	No
n-Butylbenzene	0.27	N/A	UT
Total PCBs	320	38,000	No
Tetrachloroethene	56	72,500	No
Toluene	670	1,220,000	No
Trichloroethene	3,500	32,400	No
Trichlorofluoromethane	2	N/A	UT
Xylene	8	112,000	No
Radionuclides (pCi/g)			
Americium-241	4.28	3,890	No
Cesium-134	0.01986	N/A	UT
Cesium-137	0.1744	20.8	No
Gross Alpha	35	N/A	UT
Gross Beta	37	N/A	UT
Plutonium-238	0.005	N/A	UT
Plutonium-239/240	9.75	6,110	No
Radium-226	2.96	50.6	No
Radium-228	1.874	43.9	No
Strontium-89/90	0.102	22.5	No
Uranium-233/234	2.24	4,980	No
Uranium-235	0.261	2,770	No
Uranium-238	2.22	1,580	No

[a] Chromium ESL is based on Chromium VI.
N/A = No ESL was available for that ECOI/receptor pair.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.13
Statistical Distribution and Comparison to Background for Subsurface Soil in the UWNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics (mg/kg)									
Arsenic	45	NON-PARAMETRIC	93	95	GAMMA	100	WRS	0.606	No
Nickel	44	GAMMA	100	95	NON-PARAMETRIC	83	WRS	1.000	No
Selenium	38	LOGNORMAL	0	85	NON-PARAMETRIC	19	N/A	N/A	**Yes**[a]

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
N/A = Not applicable; background data not available or not detected.
WRS = Wilcoxon Rate Sum.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.14

Statistical Concentrations in Subsurface Soil in the UWNEU[a]

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th Percentile	95th Percentile	UCL	UTL	MDC
Selenium	mg/kg	85	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.365	0.235	0.345	0.854	0.668	0.880	5.80

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the statistical concentrations.

MDC = Maximum detected concentration or in some cases, maximum proxy result.

UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.

UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

Table 7.15

Upper-Bound Exposure Point Concentration Comparison to tESLs in the UWNEU

Analyte	Burrowing Receptors		
	EPC (UTL)	tESL[a]	EPC>ESL?
Inorganics (mg/kg)			
Selenium	0.88	2.8	No

[a]Threshold ESL (if available) for the prairie dog receptor.

Table 7.16
Summary of ECOPC Screening Steps for Subsurface Soil in the UWNEU

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%	Exceeds Background?[a]	Upper-Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Inorganics						
Aluminum	UT	--	--	--	--	No
Antimony	No	--	--	--	--	No
Arsenic	Yes	Yes	No	--	--	No
Barium	No	--	--	--	--	No
Beryllium	No	--	--	--	--	No
Boron	No	--	--	--	--	No
Cadmium	No	--	--	--	--	No
Calcium	UT	--	--	--	--	No
Cesium	UT	--	--	--	--	No
Chromium	No	--	--	--	--	No
Cobalt	No	--	--	--	--	No
Copper	No	--	--	--	--	No
Iron	UT	--	--	--	--	No
Lead	No	--	--	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	UT	--	--	--	--	No
Manganese	No	--	--	--	--	No
Mercury	No	--	--	--	--	No
Molybdenum	No	--	--	--	--	No
Nickel	Yes	Yes	No	--	--	No
Nitrate / Nitrite	No	--	--	--	--	No
Potassium	UT	--	--	--	--	No
Selenium	Yes	Yes	N/A	No	--	No
Silica	UT	--	--	--	--	No
Silicon	UT	--	--	--	--	No
Silver	UT	--	--	--	--	No
Sodium	UT	--	--	--	--	No
Strontium	No	--	--	--	--	No
Thallium	No	--	--	--	--	No
Tin	No	--	--	--	--	No
Titanium	UT	--	--	--	--	No
Uranium	No	--	--	--	--	No
Vanadium	No	--	--	--	--	No
Zinc	No	--	--	--	--	No
Organics						
1,1,1-Trichloroethane	No	--	--	--	--	No
1,1-Dichloroethene	No	--	--	--	--	No
1,2,3-Trichlorobenzene	UT	--	--	--	--	No
1,2,4-Trichlorobenzene	No	--	--	--	--	No
1,2,4-Trimethylbenzene	UT	--	--	--	--	No
1,2-Dichloroethene	No	--	--	--	--	No
1234678-HpCDF	UT	--	--	--	--	No
1234789-HpCDF	UT	--	--	--	--	No
123478-HxCDF	UT	--	--	--	--	No
2378-TCDD	No	--	--	--	--	No
2-Butanone	No	--	--	--	--	No
2-Hexanone	UT	--	--	--	--	No
4-Methyl-2-pentanone	No	--	--	--	--	No
Acetone	No	--	--	--	--	No
Benzo(a)anthracene	UT	--	--	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	--	--	No
Carbon Disulfide	No	--	--	--	--	No
Carbon Tetrachloride	No	--	--	--	--	No
Chlorobenzene	No	--	--	--	--	No
Chloroform	No	--	--	--	--	No
Chrysene	UT	--	--	--	--	No
Heptachlorodibenzo-p-dioxin	UT	--	--	--	--	No
Methylene Chloride	No	--	--	--	--	No
Naphthalene	No	--	--	--	--	No
n-Butylbenzene	UT	--	--	--	--	No
OCDD	UT	--	--	--	--	No
OCDF	UT	--	--	--	--	No
PCB-1254	No	--	--	--	--	No
Tetrachloroethene	No	--	--	--	--	No

Table 7.16
Summary of ECOPC Screening Steps for Subsurface Soil in the UWNEU

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%	Exceeds Background?[a]	Upper-Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Toluene	No	--	--	--	--	No
Trichloroethene	No	--	--	--	--	No
Trichlorofluoromethane	UT	--	--	--	--	No
Xylene	No	--	--	--	--	No
Radionuclides						
Americium-241	No	--	--	--	--	No
Cesium-134	UT	--	--	--	--	No
Cesium-137	No	--	--	--	--	No
Gross Alpha	UT	--	--	--	--	No
Gross Beta	UT	--	--	--	--	No
Plutonium-238	UT	--	--	--	--	No
Plutonium-239/240	No	--	--	--	--	No
Radium-226	No	--	--	--	--	No
Radium-228	No	--	--	--	--	No
Strontium-89/90	No	--	--	--	--	No
Uranium-233/234	No	--	--	--	--	No
Uranium-235	No	--	--	--	--	No
Uranium-238	No	--	--	--	--	No

[a] Based on results of statistical analysis at the 0.1 level of significance.
'-- = Screen not performed because analyte was eliminated from further consideration in a previous ECOPC selection step.
N/A = Not applicable; background comparison could not be conducted.
UT - Uncertain toxicity; no ESL available (assessed in Section 10).

Table 8.1
Summary of ECOPC/Receptor Pairs

ECOPC	Receptors of Potential Concern
Surface Soil	
Antimony	Terrestrial plant Deer Mouse (herbivore) Deer mouse (insectivore) Prairie dog Coyote (generalist) Coyote (insectivore)
Copper	Mourning dove (herbivore) Mourning dove (insectivore)
Molybdenum	Terrestrial plant Deer mouse (insectivore)
Nickel	Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)
Silver	Terrestrial plant
Tin	American kestrel Mourning dove (herbivore) Mourning dove (insectivore) Deer mouse (insectivore)
Vanadium	Terrestrial plant Deer Mouse (herbivore) Deer mouse (insectivore)
Zinc	Terrestrial plant American kestrel Mourning dove (herbivore) Mourning dove (insectivore) Deer mouse (insectivore)
Bis(2-ethylhexyl)phthalate	American kestrel Mourning dove (insectivore)
Di-n-butylphthalate	American kestrel Mourning dove (insectivore)
Total PCBs	Mourning dove (insectivore)
Surface Soil - PMJM	
Antimony	PMJM
Nickel	PMJM
Tin	PMJM
Vanadium	PMJM
Zinc	PMJM
Subsurface Soil	
None	None

Table 8.2
Surface Soil Exposure Point Concentrations for Non-PMJM Receptors

ECOPC	Tier I Exposure Point Concentrations		Tier II Exposure Point Concentrations	
	UTL	UCL	UTL	UCL
Inorganics (mg/kg)				
Antimony	30.2	17.5	20.5[b]	14.4
Copper	31.7	20.3	65.7[b]	22.2
Molybdenum	2.8	2.86	2.60[b]	1.59
Nickel	20.1	14.5	17[b]	13.9
Silver	2.5	1.42	7.69[b]	1.49
Tin	26.4	11.8	16.1[b]	14.7
Vanadium	50.9	37.7	258[b]	55.3
Zinc	84.3	63	111[b]	67.1
Organics (µg/kg)				
Bis(2-ethylhexyl)phthalate	3,600[a]	2,480	3,600[b]	1,388
Di-n-butylphthalate	240	221	408[b]	271
Total PCBs	270	185	428[b]	300

[a]Tier 1 soil UTL was greater than the MDC, so the MDC was used as the proxy exposure point concentration.

[b]Tier 2 soil UTL and/or UCL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used as a proxy exposure point concentration.

Table 8.3
Surface Soil Exposure Point Concentrations in PMJM Patches

Analyte[a]	Number of Samples	Number of Detects	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	ESL (mg/kg)	UCL (mg/kg)
Patch 12								
Nickel	8	8	100%	7.8	15.6	13.9	0.51	15.6[b]
Tin	8	2	25%	27.4	29.7	11.7	4	29.7[b]
Vanadium	8	8	100%	18.3	39.1	29.1	21.6	33.3
Zinc	8	8	100%	35	68.4	59	6.41	66.4
Patch 15								
Nickel	1	1	100%	16	16	16	0.51	16[a]
Vanadium	1	1	100%	45	45	45	21.6	45[b]
Zinc	1	1	100%	62	62	62	6.41	62[b]
Patch 17								
Antimony	12	1	8%	0.51	9.65	2.99	1	6.78
Nickel	13	13	100%	17.5	25	13.7	0.51	15.9
Tin	12	7	58%	12.5	12.5	5.92	4	7.69
Vanadium	13	13	100%	40	40	28.3	21.6	32.7
Zinc	13	13	100%	64.1	64.1	40.4	6.41	48.4
Patch 18								
Antimony	40	20	50%	0.29	26.5	10.2	1	20.5
Nickel	40	40	100%	8.6	22.5	14.4	0.51	15.3
Tin	40	2	5%	18.6	26.4	7.05	4	9.8
Vanadium	40	40	100%	19.7	75.9	35.2	21.6	38.3
Zinc	40	40	100%	49.1	650	99.1	6.41	125

[a] ECOPCs shown on this table were detected at least once in a given patch and are only those that have patch-specific MDCs > ESL.

[b]Soil UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy exposure point concentration.

Table 8.4
Surface Water Exposure Point Concentrations for Non-PMJM and PMJM Receptors

ECOPC	MDC	UTL	UCL	Mean
Inorganics (mg/L)				
Antimony	0.078	0.025	0.014	0.011
Copper	0.242	0.022	0.015	0.009
Molybdenum	0.043	0.008	0.005	0.004
Nickel	0.165	0.014	0.009	0.007
Silver	0.006	0.003	0.002	0.001
Tin	0.072	0.025	0.012	0.008
Vanadium	0.18	0.025	0.017	0.010
Zinc	1.80	0.301	0.149	0.088
Organics (ug/L)				
Bis(2-ethylhexyl)phthala	200	5.5	11.1	6.21
Di-n-butylphthalate	9.00	5.40	4.64	4.20
Total PCBs	N/A			

N/A = Data were not available.

Table 8.5
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet				Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue	Dietary Reference						
Non-Wildlife Terrestrial Receptors												
Terrestrial Plants							N/A					
Vertebrate Receptors - Birds												
American kestrel	0.116	Brown and Amadon (1968) - Average value	0	20	80	Generalized Diet from several studies presented in the Watershed ERA DOE (1996)	0.092	Kolpin et al. (1980)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	5	Assumed value based on conservative estimates for carnivores
Mourning Dove (herbivore)	0.113	Average of adult values from CalEPA (2004) Online Database	100	0	0	Cowan (1952)	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Mourning Dove (insectivore)	0.113	Average of adult values from CalEPA (2004) Online Database	0	100	0	Generalized Diet	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Vertebrate Receptors - Mammals												
Preble's Meadow Jumping Mouse	0.019	Morrison and Ryser (1962)	70	30	0	Estimated from Whitacker (1972)	0.17	EPA (1993) - Estimated- Nagy (1987) - Rodent Model	0.15	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.4	Beyer et al. (1994) - Meadow Vole used as a conservative surrogate
Deer Mouse (herbivore)	0.0187	Flake (1973)	100	0	0	Generalized Diet	0.111	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in EPA (1993).	2	Beyer et al. (1994)

Table 8.5
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet: Plant Tissue	Percentage of Diet: Invertebrate Tissue	Percentage of Diet: Bird or Mammal Tissue	Percentage of Diet: Dietary Reference	Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
Deer Mouse (insectivore)	0.0187	Flake (1973)	0	100	0	Generalized Diet	0.065	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in USEPA 1993.	2	Beyer et al. (1994)
Prairie Dog	1.14	University of Michigan (2004) - Online	100	0	0	Generalized Diet	0.029	EPA (1993) - Estimated- Nagy (1987) - Rodent Model	0.098	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	7.7	Beyer et al. (1994)
Coyote (generalist)	12.75	Bekoff (1977) - Average of male and female weights	0	25	75	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	5	Beyer et al. (1994) - High end estimate for Red Fox
Coyote (insectivore)	12.75	Bekoff (1977) - Average of male and female weights	0	100	0	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.8	Beyer et al. (1994) - Red Fox

All receptor parameters are estimates of central tendency except where noted.
All values are presented in a dry weight basis.
N/A = Not applicable.
N/A = Not applicable.

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Antimony						
Deer Mouse - Herbivore						
Tier 1 UTL	0.1070	N/A	N/A	0.0670	0.00475	0.179
Tier 2 UTL[a]	0.0744	N/A	N/A	0.0455	0.00475	0.125
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.96	N/A	0.0393	0.00475	2.01
Tier 2 UTL[a]	N/A	1.33	N/A	0.0267	0.00475	1.36
Prairie Dog						
Tier 1 UTL	0.0280	N/A	N/A	0.0674	0.00245	0.0978
Tier 2 UTL[a]	0.0194	N/A	N/A	0.0458	0.00245	0.0677
Coyote - Generalist						
Tier 1 UCL	N/A	0.0656	0.0153	0.0131	0.00112	0.0951
Tier 2 UCL	N/A	0.0540	0.0126	0.0108	0.00112	0.0785
Coyote - Insectivore						
Tier 1 UCL	N/A	0.263	N/A	0.00735	0.00112	0.271
Tier 2 UCL	N/A	0.216	N/A	0.00605	0.00112	0.223
Copper						
Mourning Dove - Herbivore						
Tier 1 UTL	1.75	N/A	N/A	0.678	0.00264	2.43
Tier 2 UTL[a]	2.34	N/A	N/A	1.405	0.00264	3.74
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.06	N/A	0.678	0.00264	3.74
Tier 2 UTL[a]	N/A	3.71	N/A	1.405	0.00264	5.11
Molybdenum						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.380	N/A	0.00364	0.00152	0.386
Tier 2 UTL[a]	N/A	0.353	NA	0.00338	0.00152	0.358

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Nickel						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	21.9	N/A	0.430	0.00168	22.3
Tier 2 UTL[a]	N/A	18.5	N/A	0.364	0.00168	18.9
Deer Mouse - Herbivore						
Tier 1 UTL	0.1133	N/A	N/A	0.0446	0.00266	0.161
Tier 2 UTL[a]	0.1000	N/A	N/A	0.0377	0.00266	0.140
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	6.18	N/A	0.0261	0.00266	6.21
Tier 2 UTL[a]	N/A	5.23	N/A	0.0221	0.00266	5.25
Coyote - Generalist						
Tier 1 UCL	N/A	0.257	0.0306	0.0109	7.20E-04	0.299
Tier 2 UCL	N/A	0.247	0.0300	0.0104	7.20E-04	0.288
Coyote - Insectivore						
Tier 1 UCL	N/A	1.03	N/A	0.00609	7.20E-04	1.04
Tier 2 UCL	N/A	0.986	N/A	0.00584	7.20E-04	0.993
Tin						
Mourning Dove - Herbivore						
Tier 1 UTL	0.182	N/A	N/A	0.565	0.00300	0.750
Tier 2 UTL[a]	0.111	N/A	N/A	0.344	0.00300	0.458
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	6.07	N/A	0.565	0.00300	6.640
Tier 2 UTL[a]	N/A	3.70	N/A	0.344	0.00300	4.050
American Kestrel						
Tier 1 UTL	N/A	0.486	0.408	0.1214	0.00300	1.018
Tier 2 UTL[a]	N/A	0.296	0.249	0.0741	0.00300	0.622
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.72	N/A	0.0343	0.00475	1.755
Tier 2 UTL[a]	N/A	1.05	N/A	0.0209	0.00475	1.072

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Vanadium						
Deer Mouse - Herbivore						
Tier 1 UTL	0.0548	N/A	N/A	0.113	0.00475	0.173
Tier 2 UTL[a]	0.278	N/A	N/A	0.573	0.00475	0.855
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.291	N/A	0.0662	0.00475	0.362
Tier 2 UTL[a]	N/A	1.48	N/A	0.335	0.00475	1.82
Zinc						
Mourning Dove - Herbivore						
Tier 1 UTL	13.0	N/A	N/A	1.80	0.0361	14.8
Tier 2 UTL[a]	15.1	N/A	N/A	2.37	0.0361	17.5
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	84.3	N/A	1.80	0.0361	86.1
Tier 2 UTL[a]	N/A	92.2	N/A	2.37	0.0361	94.6
American Kestrel						
Tier 1 UTL	N/A	6.74	9.21	0.388	0.0361	16.4
Tier 2 UTL[a]	N/A	7.38	9.40	0.511	0.0361	17.3
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	23.8	N/A	0.110	0.0572	24.0
Tier 2 UTL[a]	N/A	26.1	N/A	0.144	0.0572	26.3
Bis(2-ethylhexyl)phthalate						
Mourning Dove - Insectivore						
Tier 1 UTL[a]	N/A	28.9	N/A	0.0770	6.60E-04	29.0
Tier 2 UTL[a]	N/A	28.9	N/A	0.0770	6.60E-04	29.0
American Kestrel						
Tier 1 UTL[a]	N/A	2.31	7.63	0.0166	6.60E-04	9.96
Tier 2 UTL[a]	N/A	2.31	7.63	0.0166	6.60E-04	9.96
Di-n-butylphthalate						
Mourning Dove - Insectivore						

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Tier 1 UTL	N/A	1.66	N/A	0.00513	6.60E-04	1.67
Tier 2 UTL[a]	N/A	2.82	N/A	0.00873	6.60E-04	2.83
American Kestrel						
Tier 1 UTL	N/A	0.133	0.502	0.00110	6.60E-04	0.637
Tier 2 UTL[a]	N/A	0.226	0.854	0.00188	6.60E-04	1.08
Total PCBs						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	0.16	N/A	0.01	N/A	0.164
Tier 2 UTL[a]	N/A	0.30	N/A	0.01	N/A	0.306
Alternative Exposure Estimates						
Nickel						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.38	N/A	0.0261	0.00171	1.41
Tier 2 UTL[a]	N/A	1.17	N/A	0.0221	0.00171	1.19

[a] Soil UTL was greater than the MDC (Tier 1) or the maximum grid mean (Tier 2), so the MDC (Tier 1) or maximum grid mean (Tier 2) was used as a proxy value to calculate intake.
NA = Not applicable or not available.

Table 8.7
PMJM Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Antimony						
Patch 17						
UCL	0.0285	0.346	N/A	0.0277	0.00210	0.404
Patch 18						
UCL	0.0806	1.05	N/A	0.0836	0.00210	1.21
Nickel						
Patch 12						
UCL[a]	0.100	3.76	N/A	0.0636	0.00135	3.93
Patch 15						
UCL[a]	0.102	3.86	N/A	0.0653	0.00135	4.03
Patch 17						
UCL	0.102	3.84	N/A	0.0649	0.00135	4.00
Patch 18						
UCL	0.0990	3.69	N/A	0.0624	0.00135	3.85
Tin						
Patch 12						
UCL[a]	0.106	1.51	N/A	0.121	0.00180	1.74
Patch 17						
UCL	0.0275	0.392	N/A	0.0314	0.00180	0.453
Patch 18						
UCL	0.0350	0.500	N/A	0.0400	0.00180	0.577
Vanadium						
Patch 12						
UCL	0.0384	0.149	N/A	0.136	0.00255	0.326
Patch 15						
UCL[a]	0.0519	0.202	N/A	0.184	0.00255	0.440
Patch 17						
UCL	0.0377	0.147	N/A	0.133	0.00255	0.320
Patch 18						
UCL	0.0442	0.172	N/A	0.156	0.00255	0.375

Table 8.7
PMJM Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Zinc						
Patch 12						
UCL	5.88	17.3	N/A	0.271	0.0224	23.4
Patch 15						
UCL[a]	5.66	16.9	N/A	0.253	0.0224	22.8
Patch 17						
UCL	4.93	15.6	N/A	0.197	0.0224	20.7
Patch 18						
UCL	8.34	21.3	N/A	0.510	0.0224	30.1
Alternative Exposure Estimates						
Nickel						
Patch 12						
UCL[a]	0.100	0.843	N/A	0.0636	0.00135	1.01
Patch 15						
UCL[a]	0.102	0.864	N/A	0.0653	0.00135	1.03
Patch 17						
UCL	0.102	0.859	N/A	0.0649	0.00135	1.03
Patch 18						
UCL	0.0990	0.826	N/A	0.0624	0.00135	0.989

[a]Soil UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to calculate intake.
NA = Not applicable or not available.

Table 9.1
TRVs for Terrestrial Plant and Invertebrate Receptors

ECOPC	Soil Concentration (mg/kg)	Endpoint	Effect Measured/Observed	Reference	Notes
Terrestrial Plants					
Antimony	5	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a	Low confidence in value.
Molybdenum	2	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a	Low confidence in value.
Silver	2	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a	Low confidence in value.
Vanadium	2	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	EPA 1980 as cited in Efroymson et al. 1997a.	Low confidence in value.
Zinc	50	Screening ESL	Effects on plant growth.	Efroymson et al. 1997a	Moderate confidence in value.

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Rationale For Calculation	TRV Confidence
Birds									
Copper	2.3	No effects noted	52.3	Increase in chicken gizzard erosion	PRC (1994)	1	2.30		High
Nickel	1.38	No increase in tremors or toe and leg joint edema	55.26	Increase in tremors and toe and knee joint edema in mallard	PRC (1994)	1	1.38	The nature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High
Tin (Butyltins)	0.73	No change in Japanese quail growth and reproduction.	18.34	Decrease in Japanese quail reproduction	PRC (1994)	1	0.73	The original paper was not reviewed. Not enough information was available to calculate the threshold TRV	High
Zinc	17.2	NOAEL was estimated from LOAEL	172	Decrease in mallard body weight	PRC (1994)	1	17.2	NOAEL was estimated from LOAEL	High
bis(2-ethylhexyl)phthalate	1.1	No reproductive effects in ringed doves	214	Increase in European starling body weight.	Sample et al. (1996)/O'Shea and Stafford (1980)	1	1.1		NOAEL High/LOAEL Low.
Di-n-butylphthalate	0.11	NOAEL estimated from LOAEL	1.1	Reduction in eggshell thickness and water permeability in ringed doves	Sample et al. (1996)	1	0.110	NOAEL was estimated from the LOAEL.	High
PCB (total)	0.09	NOAEL was estimated from LOAEL	1.27	Decrease in egg hatchability	PRC (1994)	1	0.09	NOAEL was estimated from the LOAEL.	High
Mammals									
Antimony	0.06	No change to rat progeny weight	0.59	Decrease in rat progeny weight	EPA (2003)	1	0.06	The original paper was not reviewed. Not enough information was available to calculate the threshold TRV	Very High
Molybdenum	0.26	NOAEL estimated from LOAEL	2.6	Increased incidence of runts in mice litters	Sample et al. (1996)	1	0.26		

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Rationale For Calculation	TRV Confidence
Nickel	0.133	NOAEL was estimated from LOAEL	1.33	Increase in pup mortality in rats	PRC (1994)	1	0.133	NOAEL was estimated from LOAEL	High
Tin (Butyltins)	0.25	No systemic effects	15	Midrange of effects less than mortality	PRC (1994)	1	0.25		High
Vanadium	0.21	NOAEL estimated from LOAEL	2.1	Significant reproductive effects in rats	Sample et al. (1996)	1	0.21	NOAEL was estimated from the LOAEL.	High
Zinc	9.61	NOAEL was estimated from LOAEL	411.4	Increase in fetal developmental effects in rats	PRC (1994)	1	9.61	NOAEL was estimated from LOAEL	High

Threshold TRVs were independently calculated using the procedures outlined in the CRA Methodology, Section 3.1.4.
TRV Confidence:
N/A = No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.
Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.
Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.
Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.
High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.
Very High = All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis)
Antimony	Terrestrial Plants	N/A	Tier 1	***ESL*** UTL = 6	Not Calculated
			Tier 2	***ESL*** UTL = 1	Not Calculated
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.3	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.6 ***LOAEL*** UTL = 0.06	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 33 ***LOAEL*** UTL = 3	***NOAEL*** UTL = 0.2
			Tier 2	***NOAEL*** UTL = 6 ***LOAEL*** UTL = 0.6	***NOAEL*** UTL = 0.03
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Prairie Dog	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.3 ***LOAEL*** UTL = 0.03	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Generalist)	Default	Tier 1	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UCL = 0.6 ***LOAEL*** UCL = 0.1	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 5 ***LOAEL*** UCL = 0.5	Not Calculated
			Tier 2	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Alternate TRVs (Uncertainty Analysis)
Copper	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.05	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.8 ***LOAEL*** UTL = 0.04	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Molybdenum	Terrestrial Plants	N/A	Tier 1	***ESL*** UTL = 1	Not Calculated
			Tier 2	***ESL*** UTL = 0.8	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.8 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis)
Nickel	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 16 ***Threshold*** UTL = 3 ***LOAEL*** UTL = 0.4	Not Calculated
			Tier 2	***NOAEL*** UTL = 12 ***Threshold*** UTL = 2 ***LOAEL*** UTL = 0.3	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.9 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 47 ***LOAEL*** UTL = 5	***NOAEL*** UTL = 0.2 ***LOAEL*** UTL = 0.08
			Tier 2	***NOAEL*** UTL = 34 ***LOAEL*** UTL = 3	***NOAEL*** UTL = 0.1 ***LOAEL*** UTL = 0.06
		Alternate	Tier 1	***NOAEL*** UTL = 11 ***LOAEL*** UTL = 1	***NOAEL*** UTL = 0.04 ***LOAEL*** UTL = 0.02
			Tier 2	***NOAEL*** UTL = 8 ***LOAEL*** UTL = 0.8	***NOAEL*** UTL = 0.03 ***LOAEL*** UTL = 0.01
	Coyote (Generalist)	Default	Tier 1	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	Not Calculated
			Tier 2	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	**Based on Alternate TRVs (Uncertainty Analysis)**
Silver	Terrestrial Plants	N/A	Tier 1	***ESL*** UTL = 1	Not
			Tier 2	***ESL*** UTL = 0.8	Not
Tin	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.04	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.3 ***LOAEL*** UTL = 0.01	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 9 ***LOAEL*** UTL = 0.4	Not Calculated
			Tier 2	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.4 ***LOAEL*** UTL = 0.02	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore	Default	Tier 1	***NOAEL*** UTL = 7 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.03	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	**Based on Alternate TRVs (Uncertainty Analysis)**
Vanadium	Terrestrial Plants	N/A	Tier 1	***ESL*** UTL = 25	***LOEC*** UTL = 1
			Tier 2	***ESL*** UTL = 27	***LOEC*** UTL = 1
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 0.8 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.2	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis)
Nickel	Terrestrial Plants	N/A	Tier 1	**ESL** UTL = 2	Not Calculated
			Tier 2	**ESL** UTL = 1	Not Calculated
	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 0.9 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.7 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 5 ***LOAEL*** UTL = 0.5	Not Calculated
			Tier 2	***NOAEL*** UTL = 5 ***LOAEL*** UTL = 0.5	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 0.4 ***LOAEL*** UTL = 0.04	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.4 ***LOAEL*** UTL = 0.04	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis)
Nickel	American Kestrel	Alternate (Uncertainty Analysis)	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.1	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Bis(2-ethylhexyl)phthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 26 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 10 ***LOAEL*** UTL = 0.05	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 9 ***LOAEL*** UTL = 0.05	Not Calculated
			Tier 2	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.02	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Di-n-butylphthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 15 ***LOAEL*** UTL = 2	Not Calculated
			Tier 2	***NOAEL*** UTL = 18 ***LOAEL*** UTL = 2	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 6 ***LOAEL*** UTL = 0.6	Not Calculated
			Tier 2	***NOAEL*** UTL = 7 ***LOAEL*** UTL = 0.7	Not Calculated
		Alternate	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Total PCBs	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.1	Not Calculated

Table 10.1
Hazard Quotient Summary For Non-PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Alternate TRVs (Uncertainty Analysis)
Total PCBs	Mourning Dove (Insectivore)	Default	Tier 2	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.2	Not Calculated
		Alternate (Uncertainty	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology.
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 10.2
Hazard Quotient Summary For PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs): Based on Default TRVs	Hazard Quotients (HQs): Based on Alternate TRVs (Uncertainty Analyisis)
Antimony	Patch 12	Default	UCL	Not an ECOPC	Not an ECOPC
		Alternate (Uncertainty Analysis)	UCL	Not An ECOPC	Not an ECOPC
	Patch 15	Default	UCL	Not an ECOPC	Not an ECOPC
		Alternate	UCL	Not an ECOPC	Not an ECOPC
	Patch 17	Default	UCL	***NOAEL*** UCL = 67 ***LOAEL*** UCL = 7	***NOAEL*** UCL = 0.03
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 18	Default	UCL	***NOAEL*** UCL = 202 ***LOAEL*** UCL = 21	***NOAEL*** UCL = 0.1
		Alternate	UCL	Not Calculated	Not Calculated
Nickel	Patch 12	Default	UCL[a]	***NOAEL*** UCL = 30 ***LOAEL*** UCL = 3	***NOAEL*** UCL = 0.1 ***LOAEL*** UCL = 0.05
		Alternate	UCL[a]	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	***NOAEL*** UCL = 0.03 ***LOAEL*** UCL = 0.01
	Patch 15	Default	UCL[a]	***NOAEL*** UCL = 30 ***LOAEL*** UCL = 3	***NOAEL*** UCL = 0.1 ***LOAEL*** UCL = 0.1
		Alternate	UCL[a]	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	***NOAEL*** UCL = 0.03 ***LOAEL*** UCL = 0.01
	Patch 17	Default	UCL	***NOAEL*** UCL = 30 ***LOAEL*** UCL = 3	***NOAEL*** UCL = 0.1 ***LOAEL*** UCL = 0.1
		Alternate	UCL	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	***NOAEL*** UCL = 0.03 ***LOAEL*** UCL = 0.01
	Patch 18	Default	UCL	**NOAEL** UCL = 29 **LOAEL** UCL = 3	***NOAEL*** UCL = 0.1 ***LOAEL*** UCL = 0.05
		Alternate	Based on Mea	***NOAEL*** UCL = 7 ***LOAEL*** UCL = 0.7	***NOAEL*** UCL = 0.02 ***LOAEL*** UCL = 0.01

Table 10.2
Hazard Quotient Summary For PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs): Based on Default TRVs	Hazard Quotients (HQs): Based on Alternate TRVs (Uncertainty Analysis)
Tin	Patch 12	Default	UCL[a]	***NOAEL*** UCL = 7 ***LOAEL*** UCL = 0.1	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 15	Default	UCL	Not an ECOPC	Not an ECOPC
		Alternate	UCL	Not an ECOPC	Not an ECOPC
	Patch 17	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.03	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 18	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.04	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
Vanadium	Patch 12	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 15	UCL[a]	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 17	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 18	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated

Table 10.2
Hazard Quotient Summary For PMJM Receptors in the UWNEU

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Alternate TRVs (Uncertainty Analysis)
Zinc	Patch 12	Default	UCL	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.1	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 15	Default	UCL[a]	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.1	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 17	Default	UCL	***NOAEL*** UCL = 2 ***LOAE*** L UCL = 0.1	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated
	Patch 18	Default	UCL	***NOAEL*** UCL = 3 ***LOAEL*** UCL = 0.1	Not Calculated
		Alternate	UCL	Not Calculated	Not Calculated

[a] Not enough samples were available to calculate a UCL. The MDC was used as a default.
Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology.
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 10.3
Tier 2 Grid Cell Hazard Quotients for Surface Soil in UWNEU

ECOPC	Most Sensitive Receptor	Number of Grid Cells	Percent of Tier 2 Grid Means											
			NOAEL TRV				Threshold TRV				LOAEL TRV			
			HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10	HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10	HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10
Inorganics														
Antimony	Deer Mouse - Insectivore	28	39	21	29	11	N/A	N/A	N/A	N/A	100	0	0	0
Copper	Mourning Dove - Insectivore	28	0	93	7	0	100	0	0	0	100	0	0	0
Molybdenum	Deer Mouse - Insectivore	28	75	25	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Nickel	Deer Mouse - Insectivore	28	0	0	0	100	N/A	N/A	N/A	N/A	0	100	0	0
Tin	Mourning Dove - Insectivore	28	43	54	4	0	N/A	N/A	N/A	N/A	100	0	0	0
Vanadium	Deer Mouse - Insectivore	28	32	64	4	0	N/A	N/A	N/A	N/A	100	0	0	0
Zinc	Mourning Dove - Insectivore	28	0	0	0	100	N/A	N/A	N/A	N/A	100	0	0	0
Organics														
Bis(2-ethylhexyl)phthalate	Mourning Dove - Insectivore	17	18	76	0	6	N/A	N/A	N/A	N/A	100	0	0	0
Di-N-Butylphthalate	Mourning Dove - Insectivore	17	0	0	0	100	N/A	N/A	N/A	N/A	0	100	0	0
Total PCBs	Mourning Dove - Insectivore	17	6	94	0	0	N/A	N/A	N/A	N/A	100	0	0	0

N/A = No value available.
The limiting receptor is chosen as the receptor with the lowest ESL.

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Antimony	Terrestrial plants	Tier 1 and Tier 2 HQs > 1. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low to Moderate Risk
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Mourning dove (herbivore)	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Mourning dove (insectivore)	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Deer mouse (herbivore)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (Insectivore)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs >1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low to Moderate Risk
	Prairie dog	NOAEL HQs >=1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Coyote (insectivore)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Copper	Terrestrial plants	Not an ECOPC.	Low Risk
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	NOAEL HQs =1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Mourning dove (insectivore)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Molybdenum	Terrestrial plants	Tier 1 and Tier 2 HQs = 1. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs = 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Nickel	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs > 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (herbivore)	NOAEL HQs = 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (Insectivore)	NOAEL and LOAEL HQs > 1 using default exposure and TRVs. NOAEL HQs >1 using alternative exposure and default TRVs. LOAEL HQs <1 using alternate exposure and default TRVs. NOAEL and LOAEL HQs <1 using default exposure and alternative TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	NOAEL HQs > 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimates based on the maximum grid mean.	Low Risk
	Coyote (insectivore)	NOAEL HQs > 1 using default exposure and TRVs. LOAEL HQs <= 1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Silver	Terrestrial plants	Tier 1 HQs = 1. Tier 2 HQs >1. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC[a].	
	Mourning dove (herbivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Mourning dove (insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Deer mouse (herbivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Deer mouse (Insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Prairie dog	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (carnivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (generalist)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Mule Deer	Not an ECOPC[a].	ECOPC of Uncertain Risk
Tin	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Tier 1 NOAEL HQ = 1 using default exposure and TRVs. Tier 1 LOAEL HQ <1 using default exposure and TRVs. Tier 2 NOAEL and LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Mourning dove (herbivore)	Tier 1 NOAEL HQ = 1 using default exposure and TRVs. Tier 1 LOAEL HQ <1 using default exposure and TRVs. Tier 2 NOAEL and LOAEL HQs <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Mourning dove (insectivore)	NOAEL HQs > 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs > 1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Vanadium	Terrestrial plants	Tier 1 and Tier 2 HQs > 1 using default TRV. Tier 1 HQ =1 using alternative TRV. Tier 2 HQ >1 using alternative TRV. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (herbivore)	Tier 1 NOAEL and LOAEL HQs < 1 using default exposure and TRVs. Tier 2 NOAEL HQ >1 using default exposure and TRVs. Tier 2 LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Deer mouse (Insectivore)	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs < 1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Zinc	Terrestrial plants	Tier 1 and Tier 2 HQs >1. Tier 2 risk estimate for UTL based on the maximum grid mean.	Low Risk
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Tier 1 NOAEL and LOAEL HQs <1 using default exposure and TRVs. Tier 2 NOAEL HQ =1 using default exposure and TRVs. Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Mourning dove (herbivore)	Tier 1 NOAEL and LOAEL HQs <1 using default exposure and TRVs. Tier 2 NOAEL HQ =1 using default exposure and TRVs. Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Mourning dove (insectivore)	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Bis(2-ethylhexyl)phthala	Terrestrial plants	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 1 risk estimates for UTL based on MDC. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 1 risk estimates for UTL based on MDC. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Di-n-butylphthalate	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on maximum grid mean.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL and LOAEL HQs >1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low to Moderate risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Total PCBs	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Tier 1 and Tier 2 NOAEL HQs >1 using default exposure and TRVs. Tier 1 and Tier 2 LOAEL HQ <1 using default exposure and TRVs. Tier 2 risk estimates for UTL based on the maximum grid mean.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	
Surface Soil - PMJM Receptors			
Antimony	Patch 12	Not detected and not an ECOPC	Not an ECOPC
	Patch 15	Not detected and not an ECOPC	Not an ECOPC
	Patch 17	NOAEL HQ >1 using default exposure and TRVs. LOAEL HQ <1 using default exposure and TRVs.	Low Risk
	Patch 18	NOAEL and LOAEL HQ >1 using default exposure and TRVs.	Low to Moderate Risk
Nickel	Patch 12	NOAEL and LOAEL HQ >1 using default exposure and TRVs. NOAEL HQs >1 using alternative exposure and default TRVs. LOAEL HQs <1 using alternative exposure and default TRVs. NOAEL and LOAEL HQs <1 using default exposure and alternate TRVs. UCL could not be calculated so MDC was used to estimate risk.	Low Risk
	Patch 15	NOAEL and LOAEL HQ >1 using default exposure and TRVs. NOAEL HQs >1 using alternative exposure and default TRVs. LOAEL HQs <1 using alternative exposure and default TRVs.	Low Risk
	Patch 17	NOAEL and LOAEL HQ >1 using default exposure and TRVs. NOAEL HQs >1 using alternative exposure and default TRVs. LOAEL HQs <1 using alternative exposure and default TRVs. NOAEL and LOAEL HQs <1 using default exposure and alternate TRVs.	Low Risk

Table 11.1
Summary of Risk Characterization Results for the UWNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
	Patch 18	NOAEL and LOAEL HQ >1 using default exposure and TRVs. NOAEL HQs >1 using alternative exposure and default TRVs. LOAEL HQs <1 using alternative exposure and default TRVs. NOAEL and LOAEL HQs <1 using default exposure and alternate TRVs.	Low Risk
Tin	Patch 12	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. UCL could not be calculated; risk estimates based on MDC.	Low Risk
	Patch 15	Not detected and not an ECOPC	Not an ECOPC
	Patch 17	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Patch 18	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
Vanadium	Patch 12	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Patch 15	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. UCL could not be calculated; risk estimates based on MDC.	Low Risk
	Patch 17	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Patch 18	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
Zinc	Patch 12	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Patch 15	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs. UCL could not be calculated; risk estimates based on MDC.	Low Risk
	Patch 17	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
	Patch 18	NOAEL HQs >1 using default exposure and TRVs. LOAEL HQs <1 using default exposure and TRVs.	Low Risk
Subsurface Soil			
None	Prairie dog	No ECOPCs.	No ECOPCs

[a]ESL was not available. Analyte evaluated in Section 10.

FIGURES

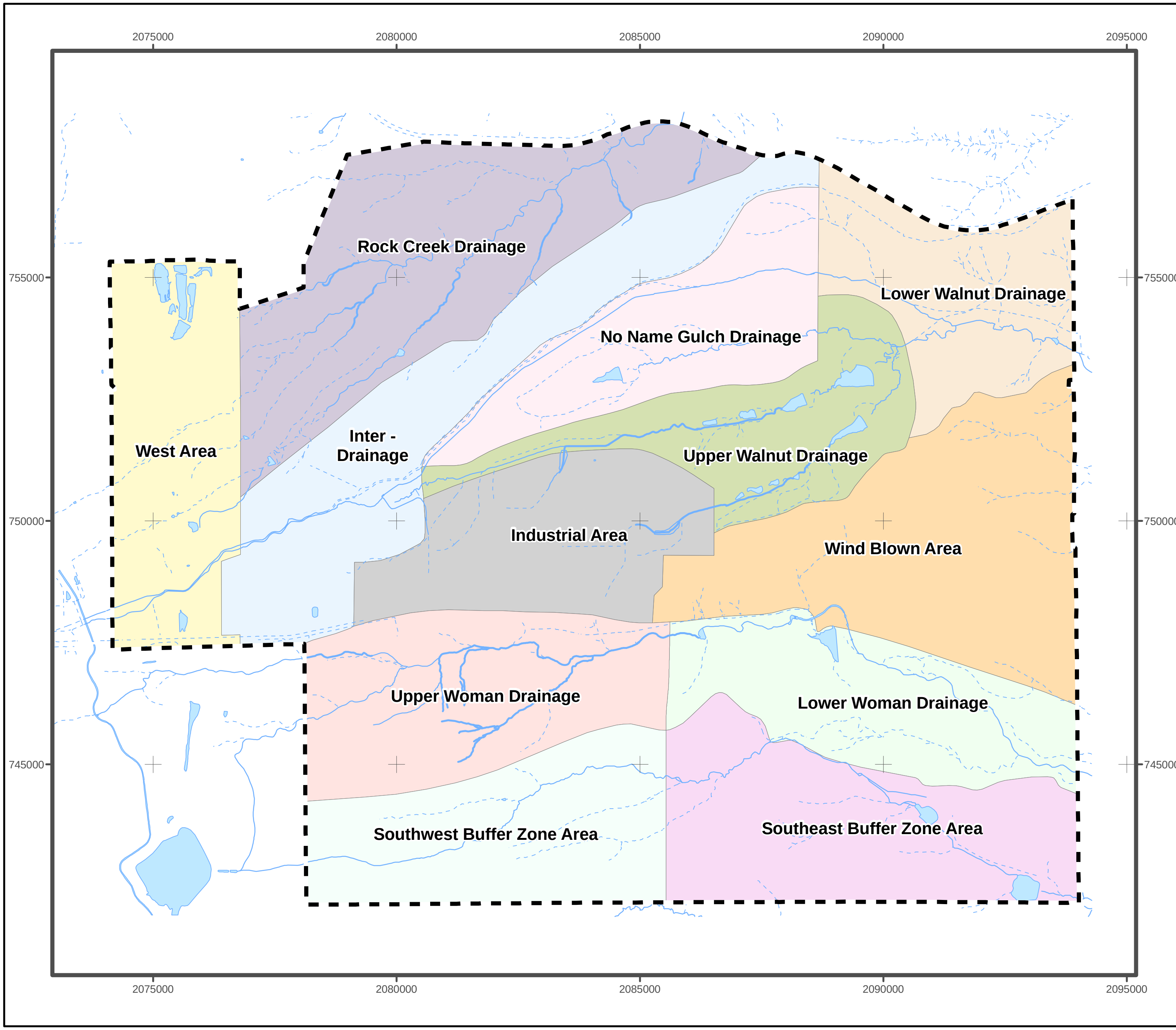

Figure 1.1
Rocky Flats Environmental
Technology Site
Exposure Units

KEY

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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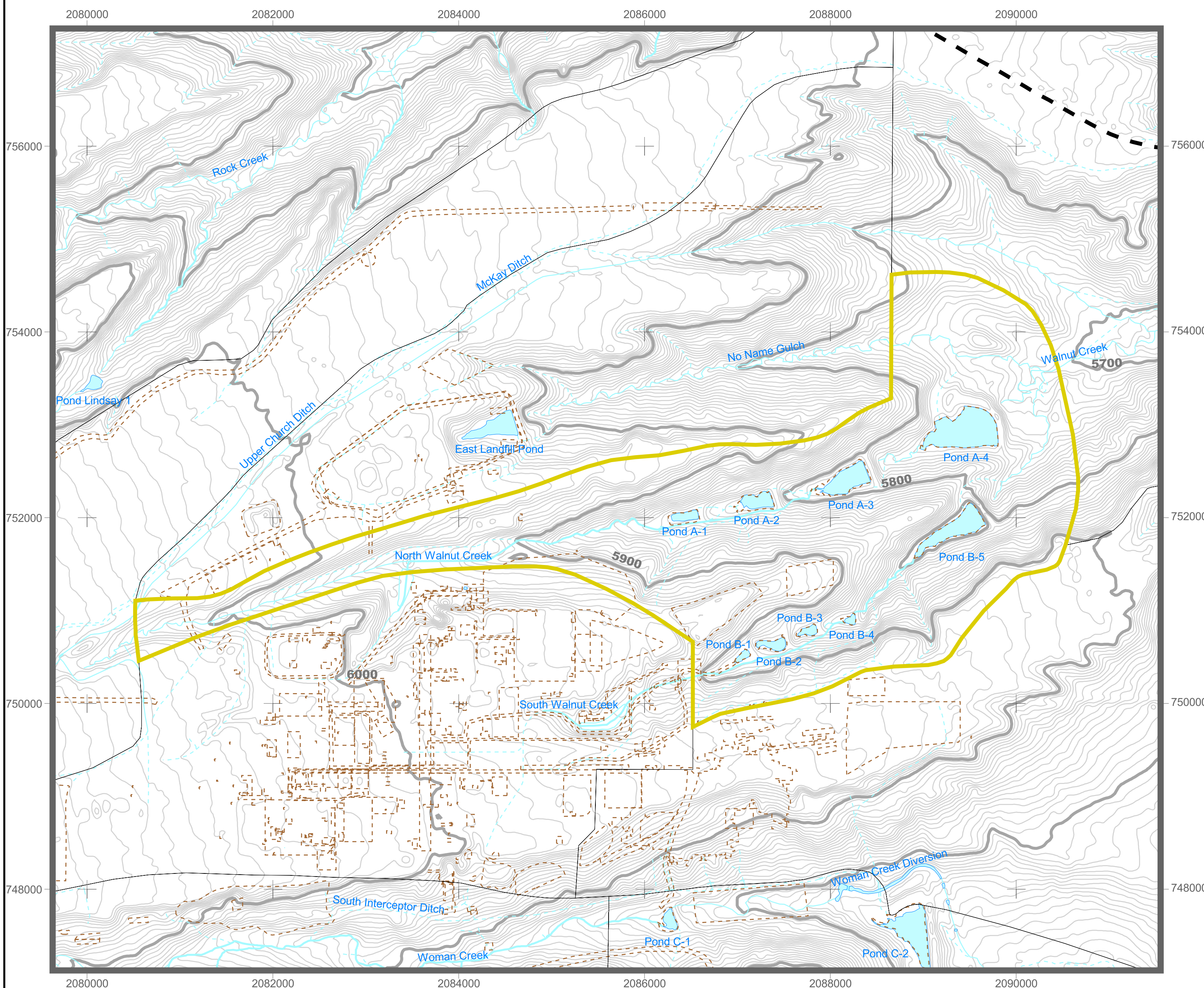


Figure 1.2
Topography and Historical IHSS Locations in the Upper Walnut Drainage Exposure Unit

KEY

Upper Walnut Drainage EU
Historical IHSS/PAC
Topographic contour interval = 5 ft.

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W
E
S

0 800 1600 Feet

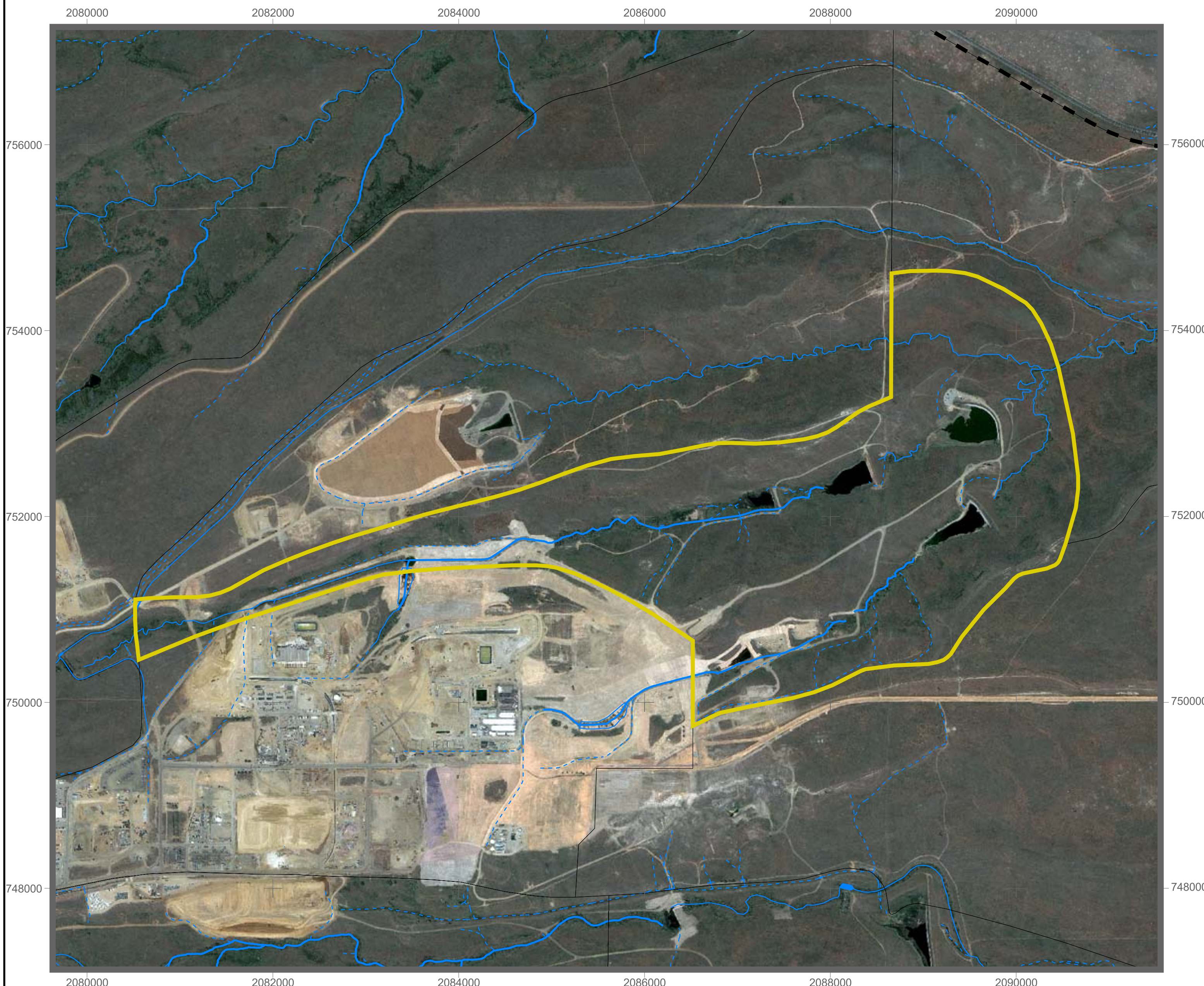
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

Figure 1.3
Aerial Photograph of the Upper Walnut Drainage Exposure Unit
July 2005



KEY

Upper Walnut Drainage EU

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

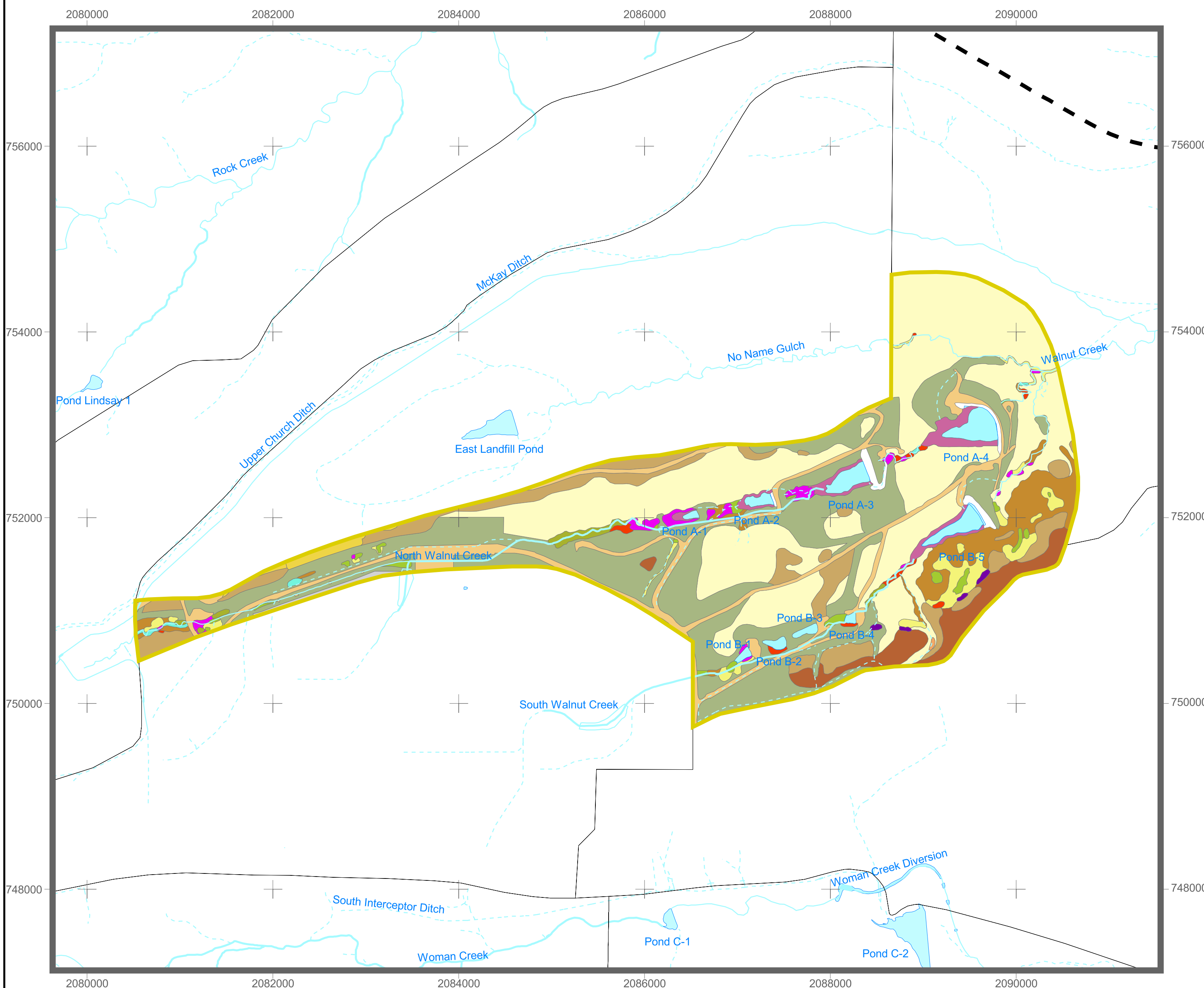


Figure 1.4
Vegetation in the Upper Walnut Drainage Exposure Unit

KEY

Upper Walnut Drainage EU

Vegetation, 2005

- Annual grass/forb community
- Disturbed areas
- Disturbed and revegetated areas
- Leadplant riparian shrubland
- Mesic mixed grassland
- Mudflats
- Open water
- Ponderosa woodland
- Reclaimed mixed grassland
- Riparian woodland
- Riprap, rock, and gravel piles
- Savannah shrubland
- Short grassland
- Short marsh
- Short upland shrubland
- Tall marsh
- Tall upland shrubland
- Tree plantings
- Wet meadow/marsh ecotone
- Willow riparian shrubland
- Xeric needle and thread grass prairie
- Xeric tallgrass prairie

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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W E
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0 800 1600 Feet

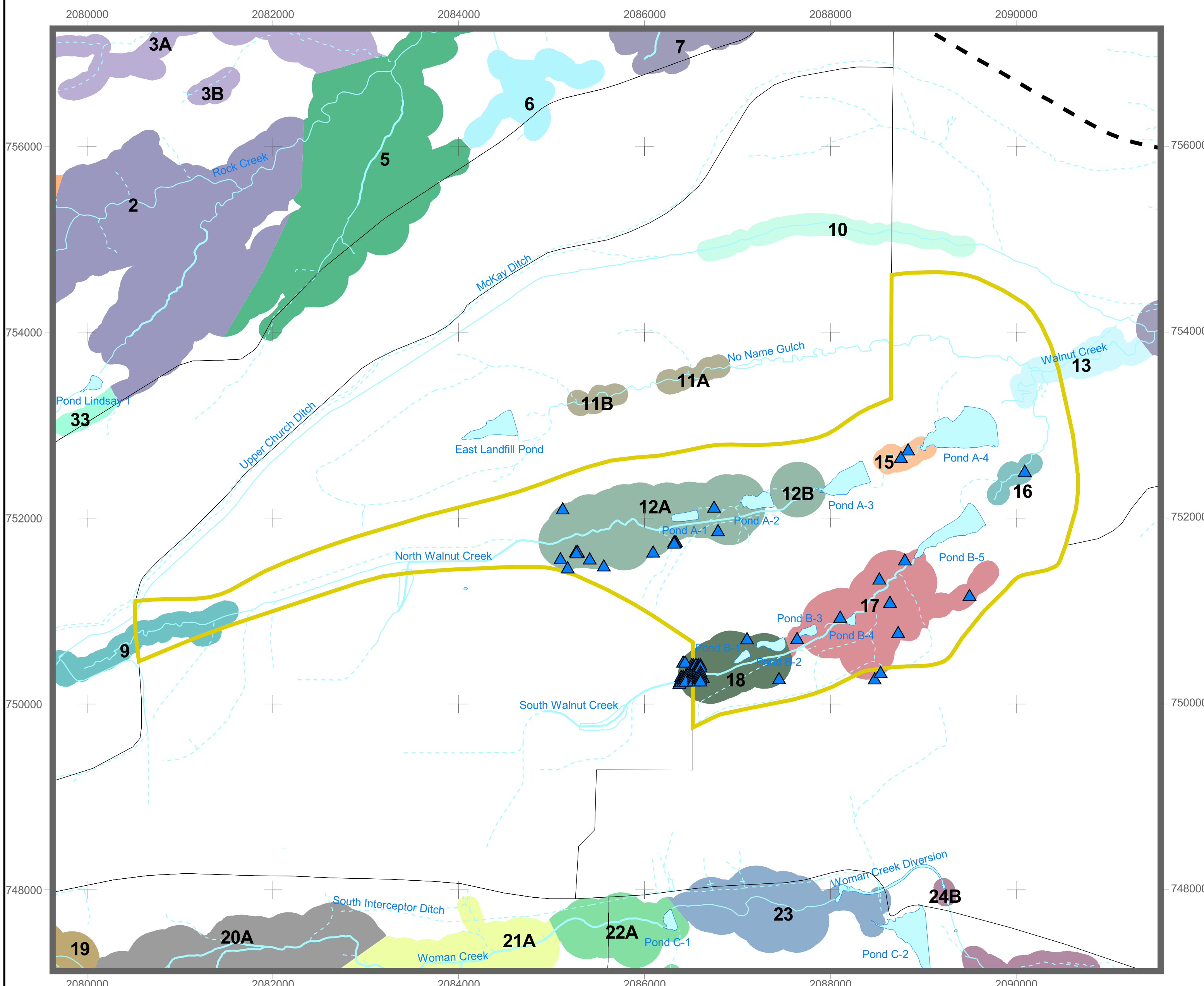
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

Figure 1.5
Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the Upper Walnut Drainage Exposure Unit



KEY

- Surface soil sample location
- Upper Walnut Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

Note: Not all analyte groups were analyzed at every sample location.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

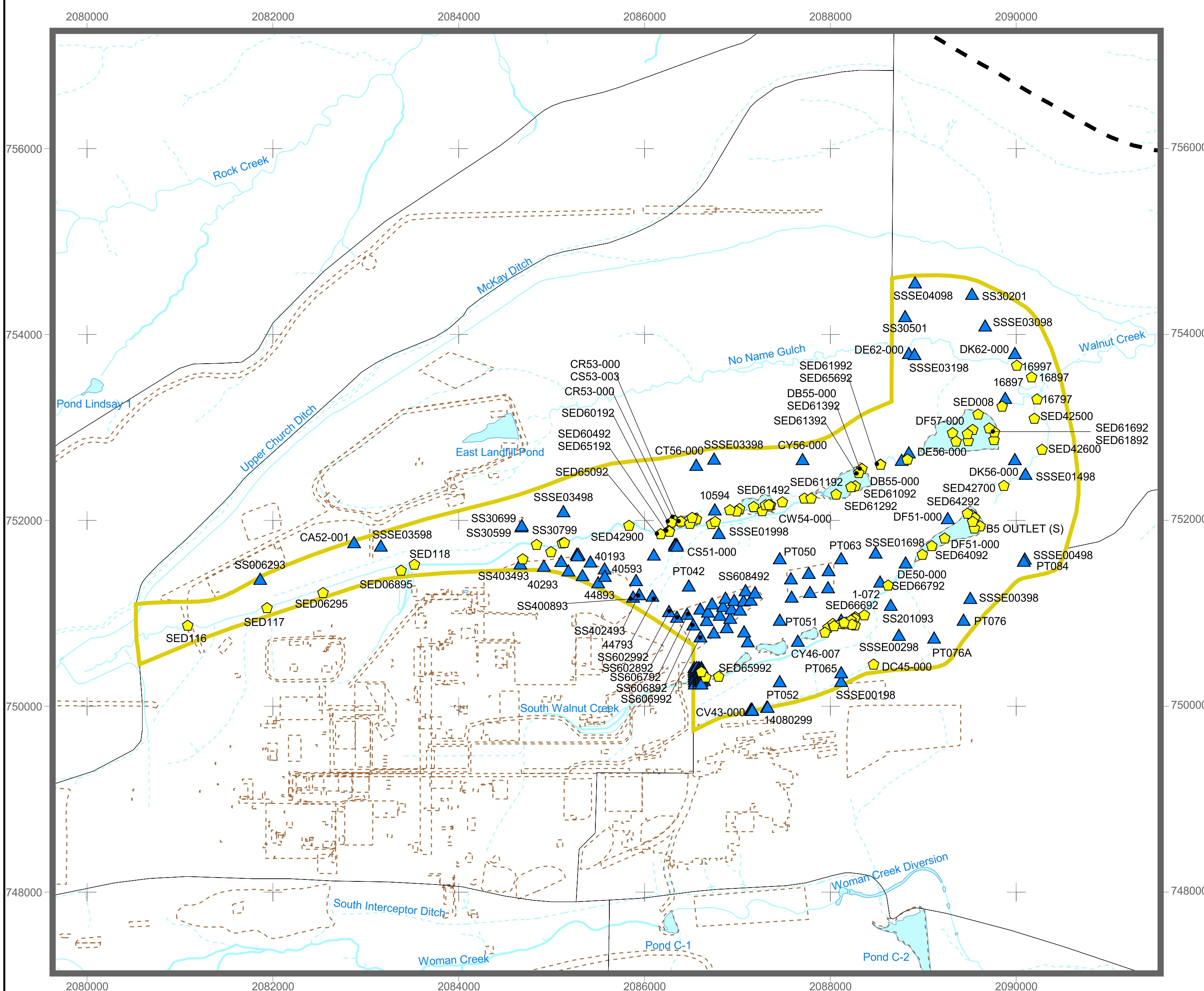

Figure 1.6
Upper Walnut Drainage Exposure Unit Surface Soil and Surface Sediment Sample Locations

KEY

Sample location

- Surface sediment sample location
- Surface soil sample location
- Upper Walnut Drainage EU
- Historical IHSS/PAC

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 800 1600 Feet

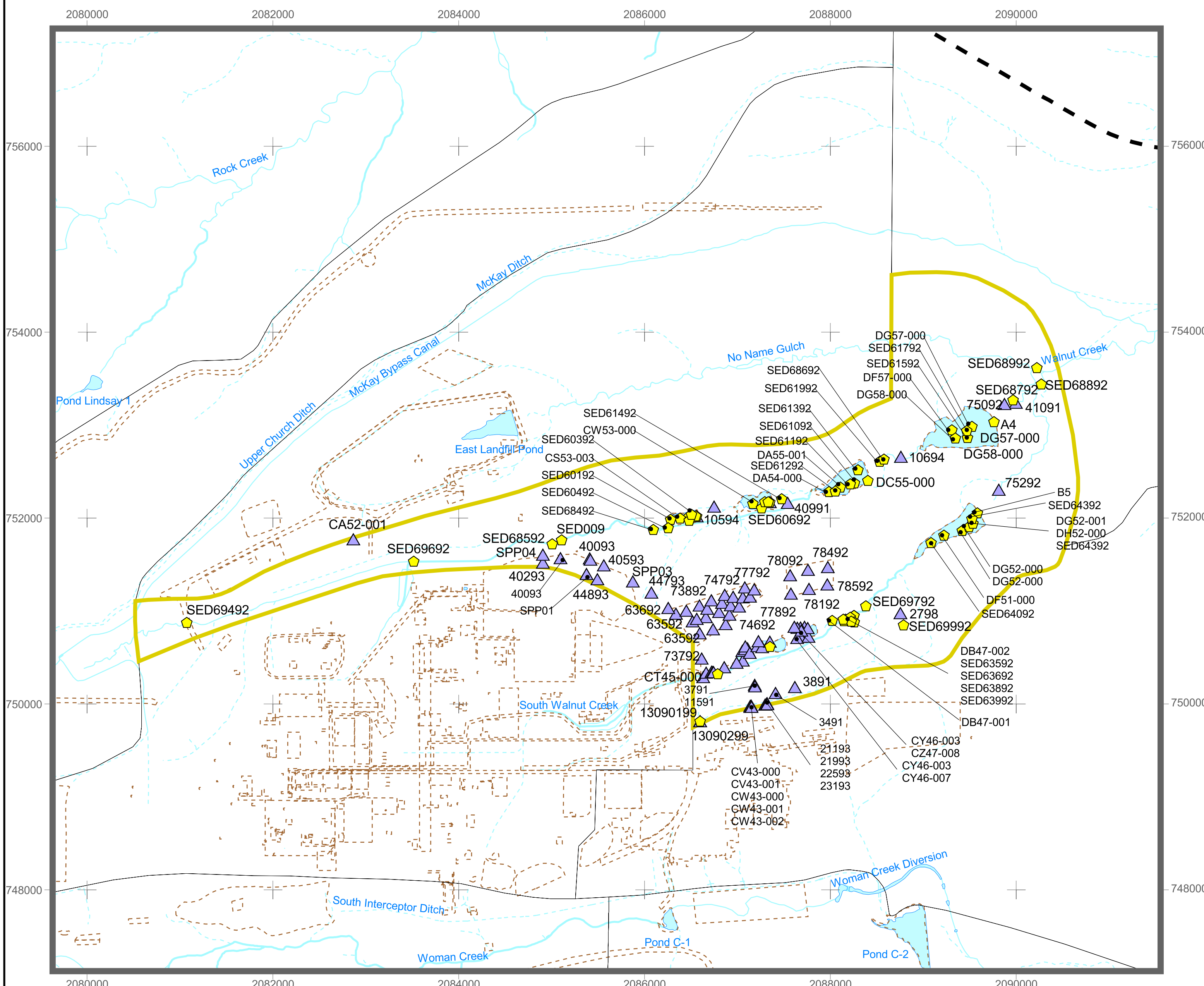
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

Figure 1.7
Upper Walnut Drainage Exposure Unit Subsurface Soil and Subsurface Sediment Sample Locations



KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location
- Upper Walnut Drainage EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 800 1600 Feet

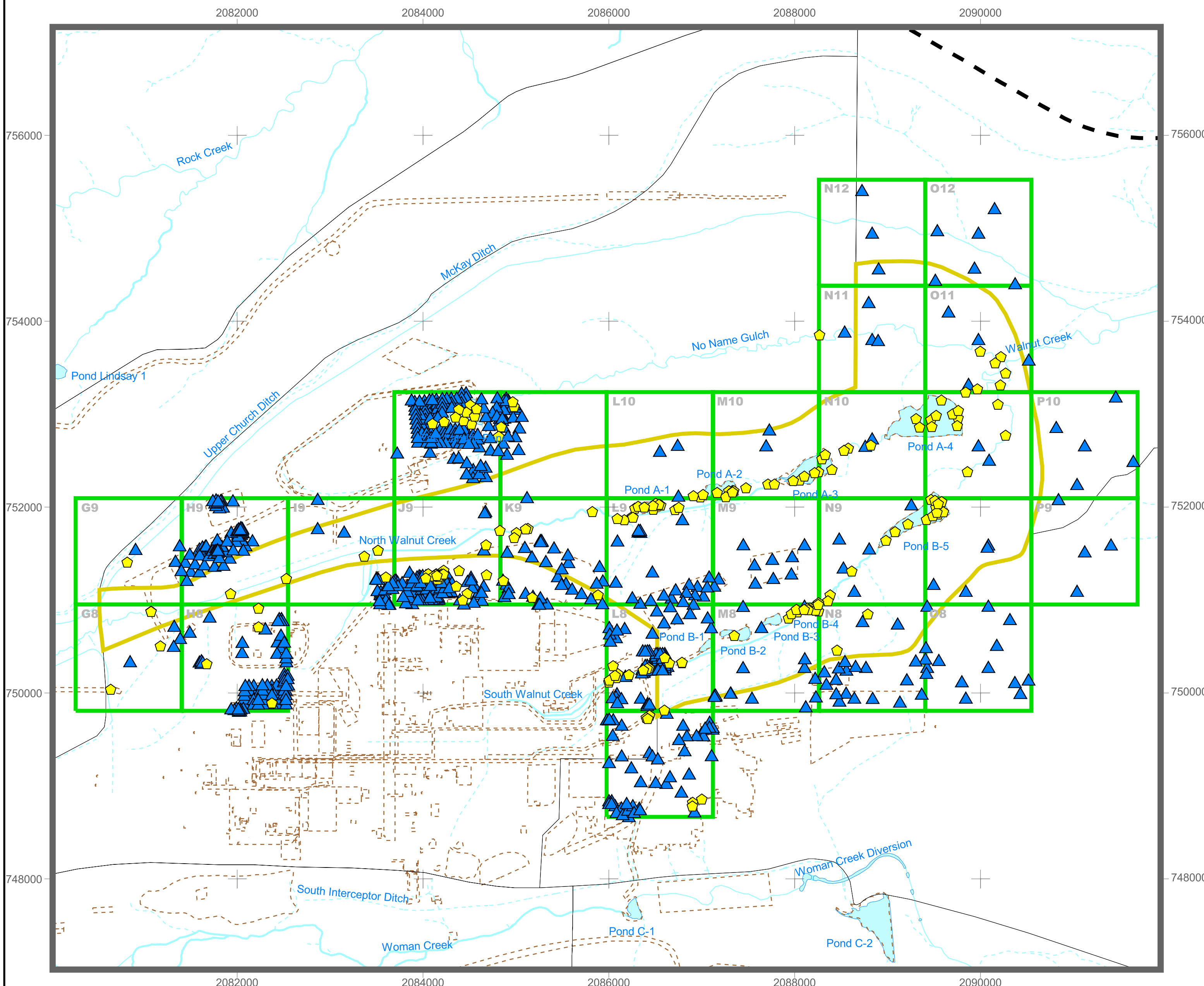
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWalnut.apr

Figure 3.1
Tier 2 EPC 30-acre Grids
with Surface Soil and Surface
Sediment Sample Locations



KEY

- Surface sediment sample location
- Surface soil sample location
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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W E
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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section3\UpperWalnut.apr

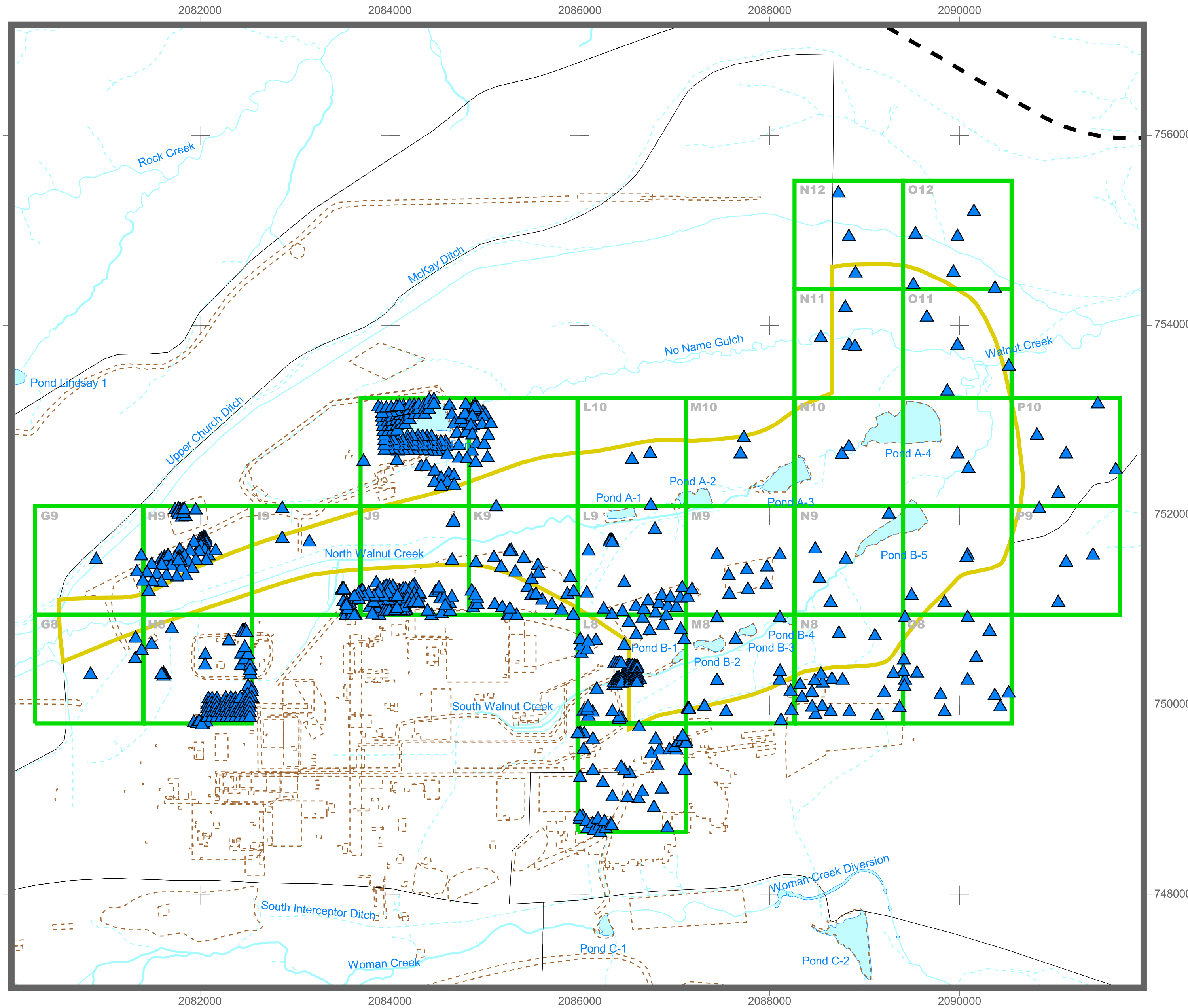


Figure 8.1
Tier 2 EPC 30-acre Grids
with Surface Soil
Sample Locations

KEY

Surface soil sample location
Upper Walnut Drainage EU
30-acre grid
Historical IHSS/PAC
A1 Grid cell ID

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 800 1600 Feet

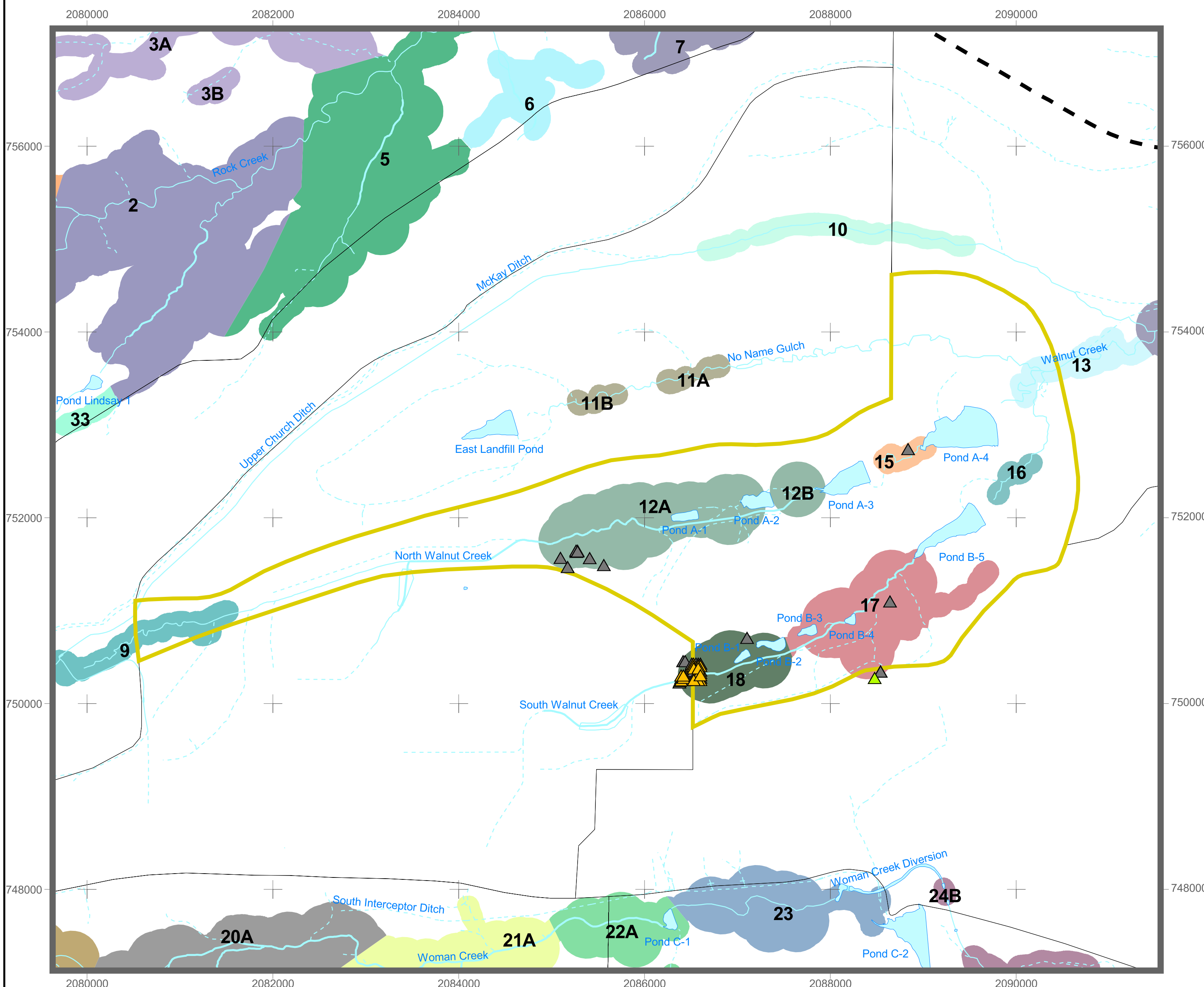
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr

Figure 8.2
Upper Walnut Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Antimony



KEY

Surface soil sample location
- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Walnut Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1.0 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 800 1600 Feet

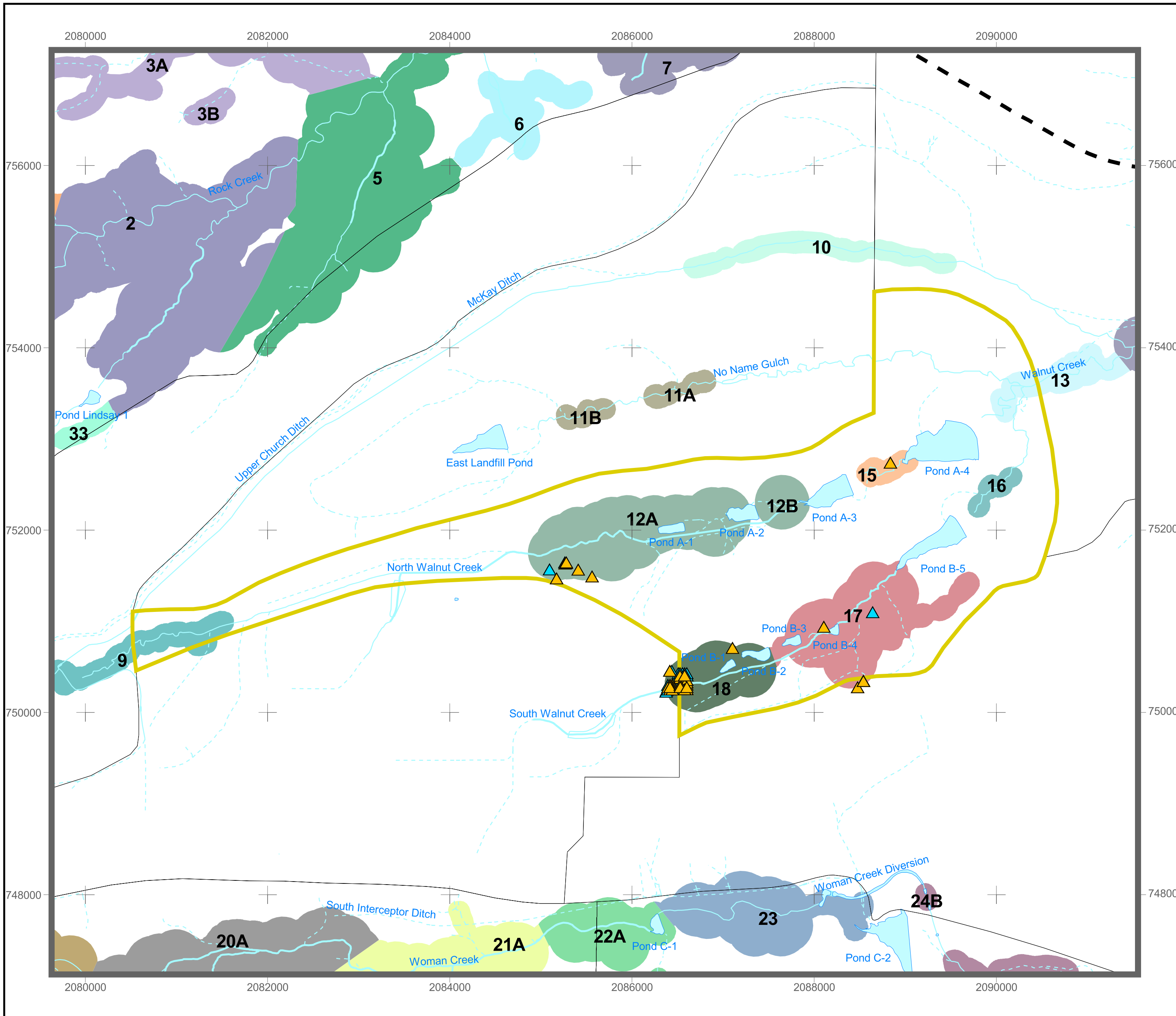
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr

Figure 8.3
Upper Walnut Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Nickel



KEY

Surface soil sample location
- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Walnut Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 0.51 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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E
S

0 800 1600 Feet

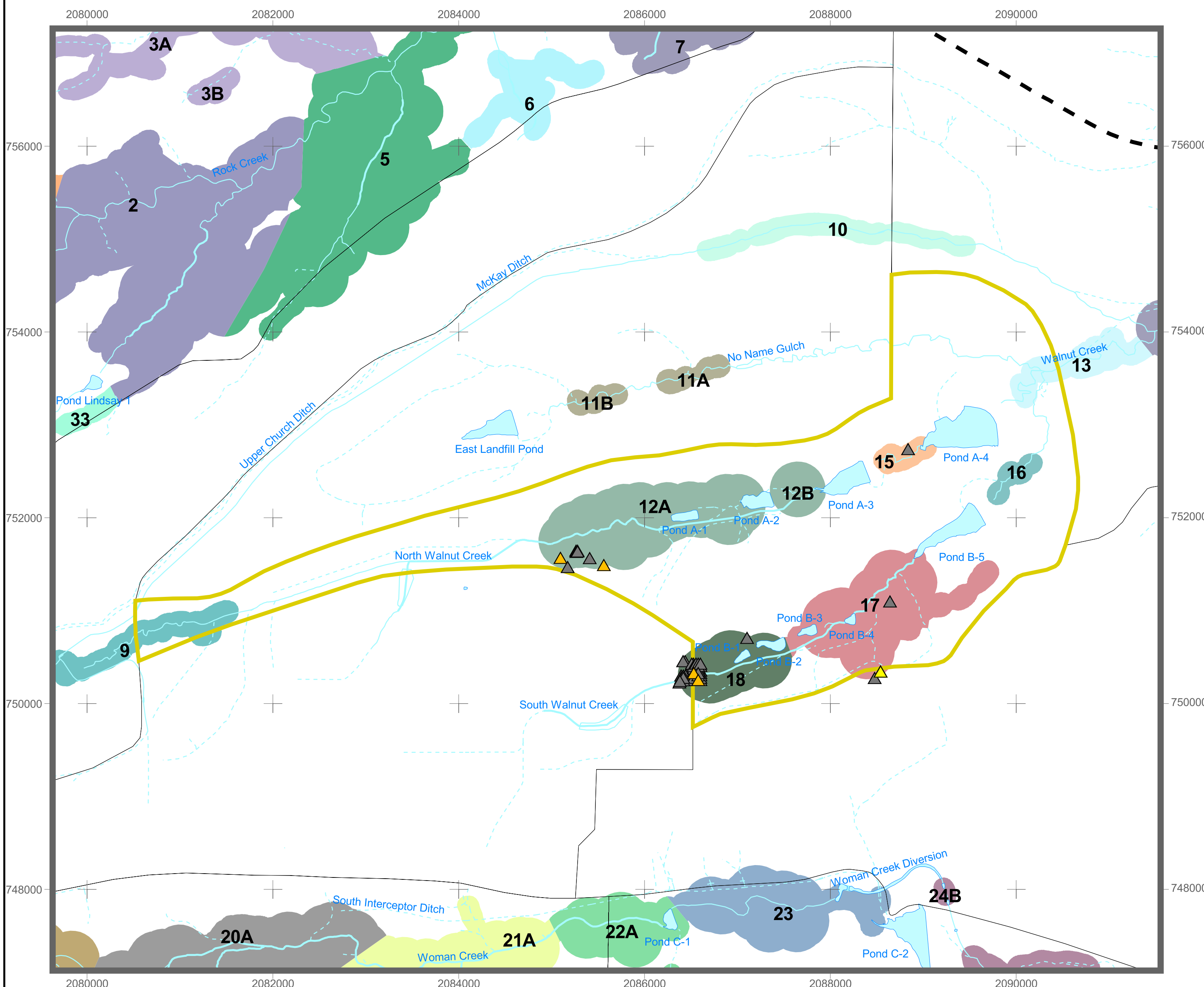
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr

Figure 8.4
Upper Walnut Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Tin



KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Walnut Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 4.21 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 800 1600 Feet

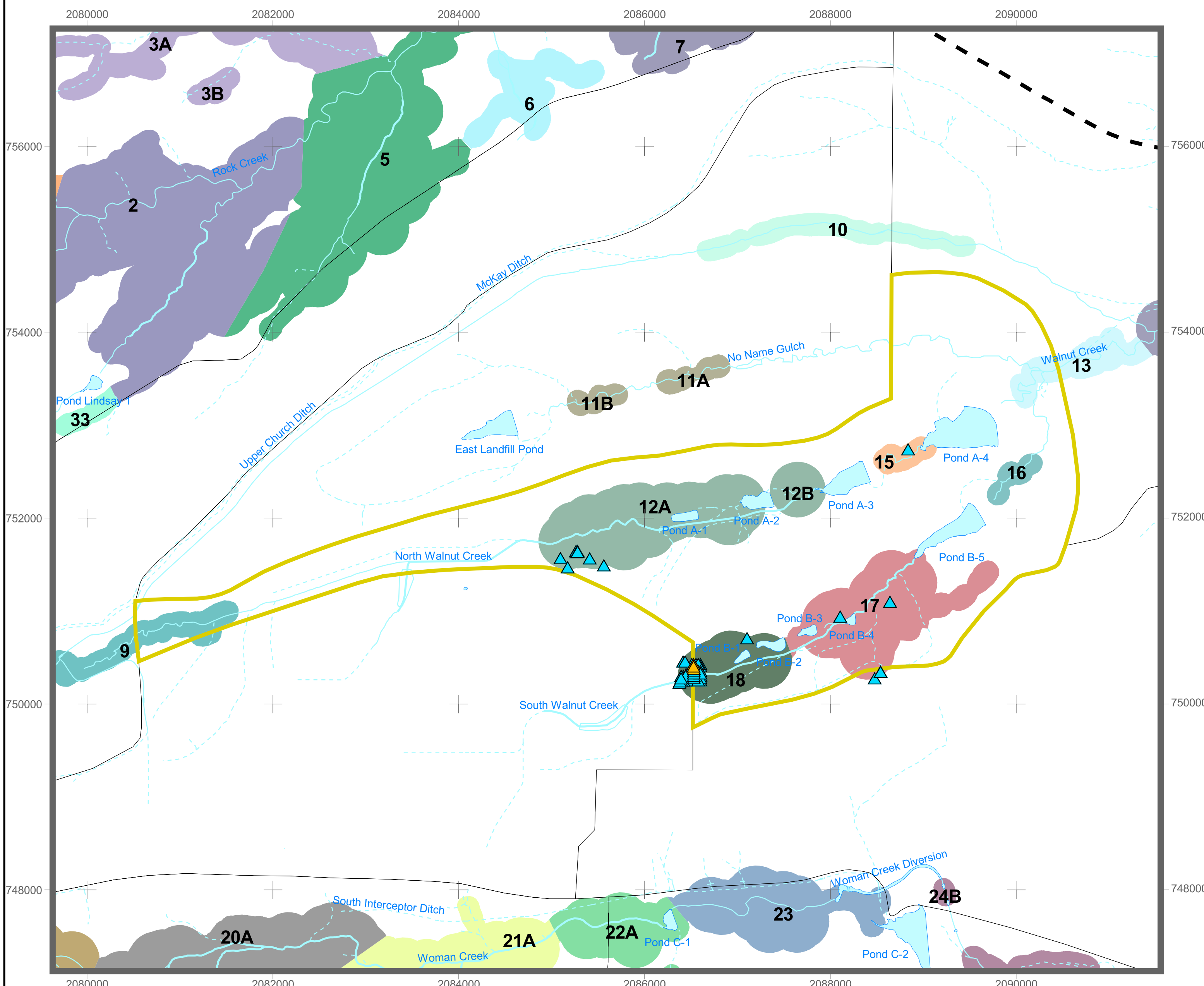
Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr

Figure 8.5
Upper Walnut Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Vanadium



KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Walnut Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 21.6 mg/kg
Maximum background concentration: 45.8 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S W E

0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr

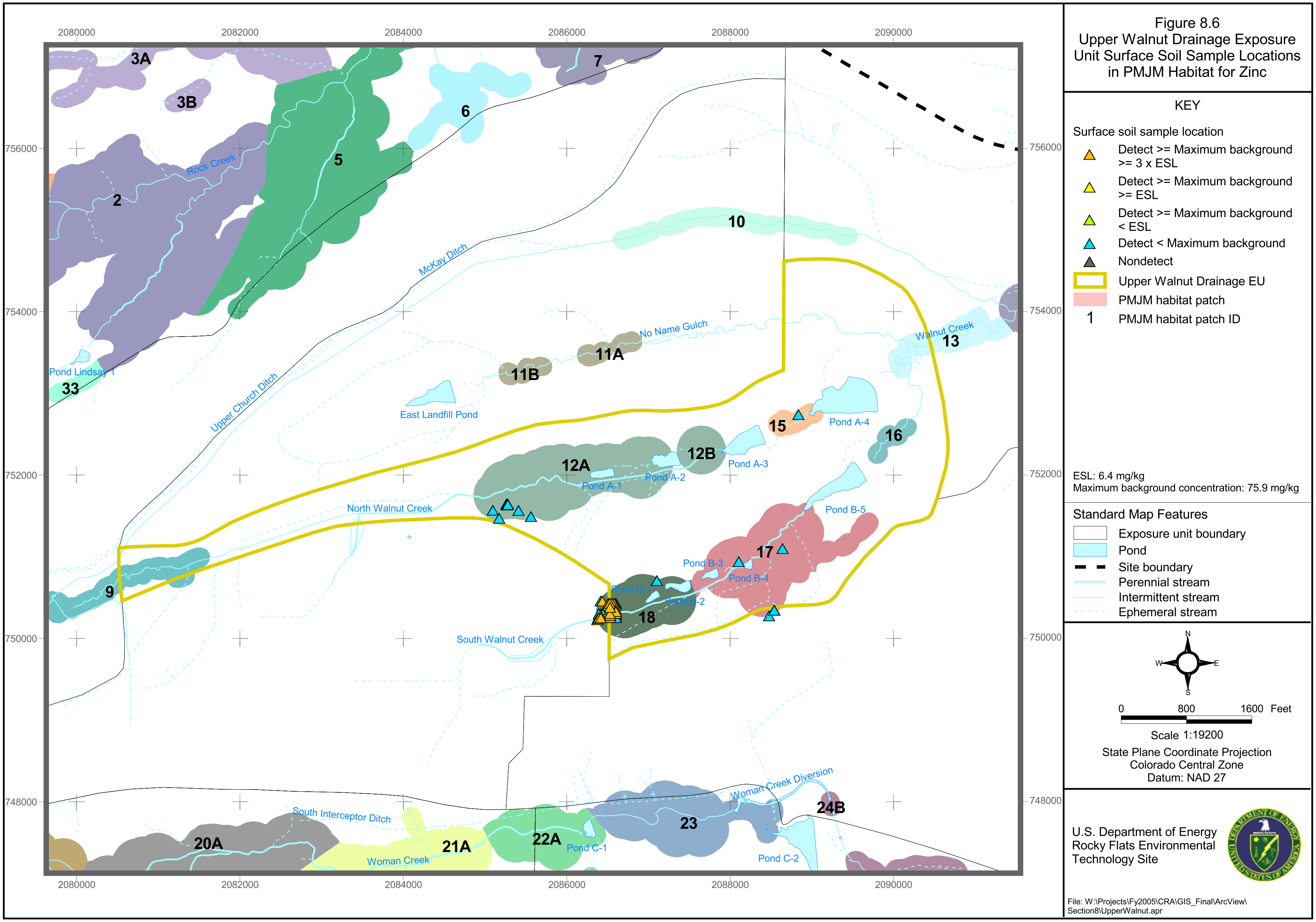
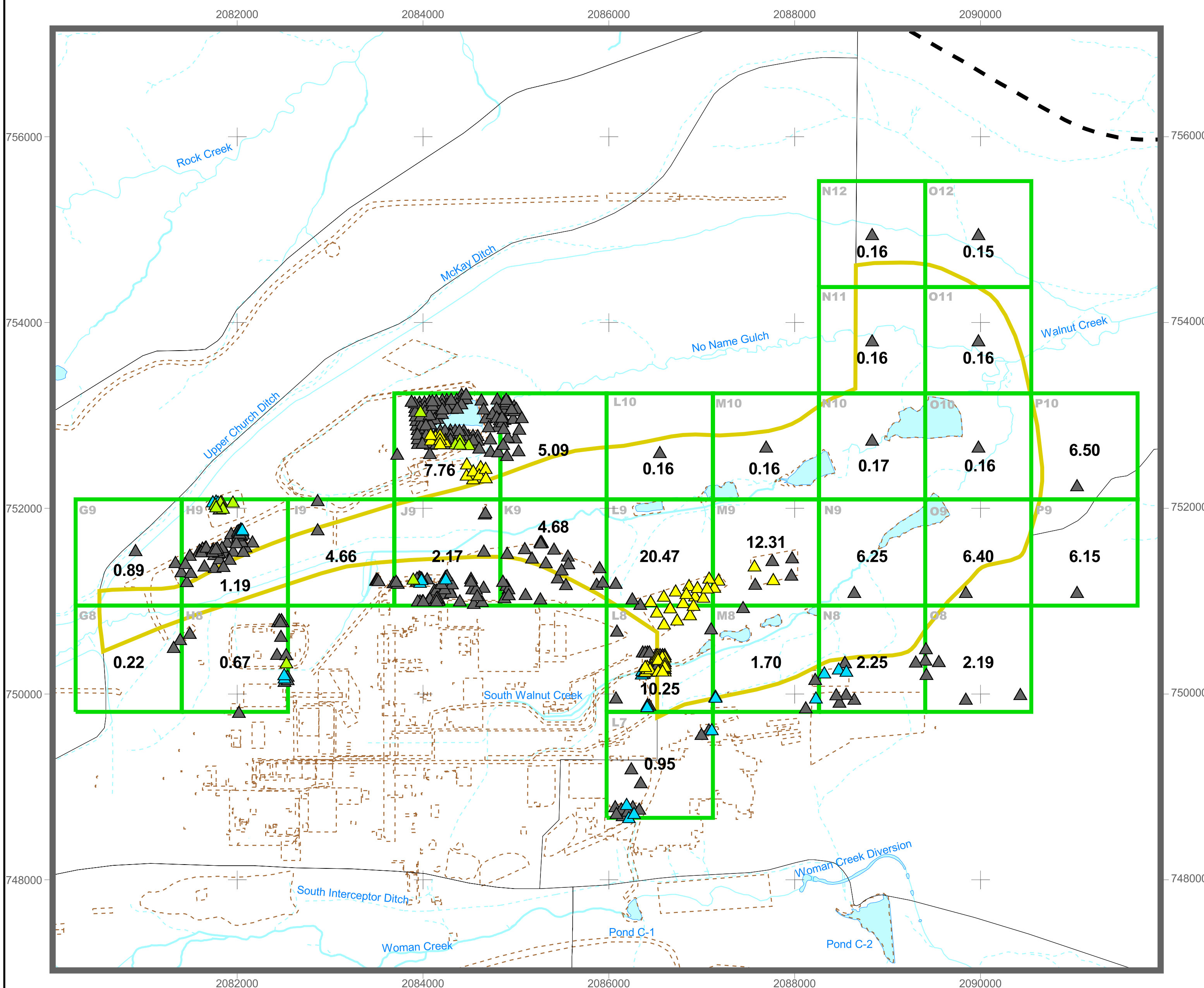


Figure 8.6
Upper Walnut Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Zinc
KEY
Surface soil sample location
Detect >= Maximum background >= 3 x ESL
Detect >= Maximum background >= ESL
Detect >= Maximum background < ESL
Detect < Maximum background
Nondetect
Upper Walnut Drainage EU
PMJM habitat patch
1 PMJM habitat patch ID
ESL: 6.4 mg/kg
Maximum background concentration: 75.9 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
S
E
W
0
800
1600 Feet
Scale 1:19200
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWalnut.apr
2080000
2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
748000
3A
3B
7
6
5
2
10
Rock Creek
McKay Ditch
No Name Gulch
Walnut Creek
13
11A
11B
Pond Lindsay 1
33
Upper Church Ditch
East Landfill Pond
15
Pond A-4
16
12B
12A
Pond A-3
Pond A-2
Pond A-1
North Walnut Creek
Pond B-5
17
Pond B-3
Pond B-4
Pond B-1
Pond B-2
9
18
South Walnut Creek
Woman Creek Diversion
24B
South Interceptor Ditch
20A
21A
22A
23
Pond C-1
Woman Creek
Pond C-2

Figure 10.1
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Antimony



KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.905 mg/kg
Receptor: Deer Mouse (Insectivore)
95th UCL background: 0.309 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr

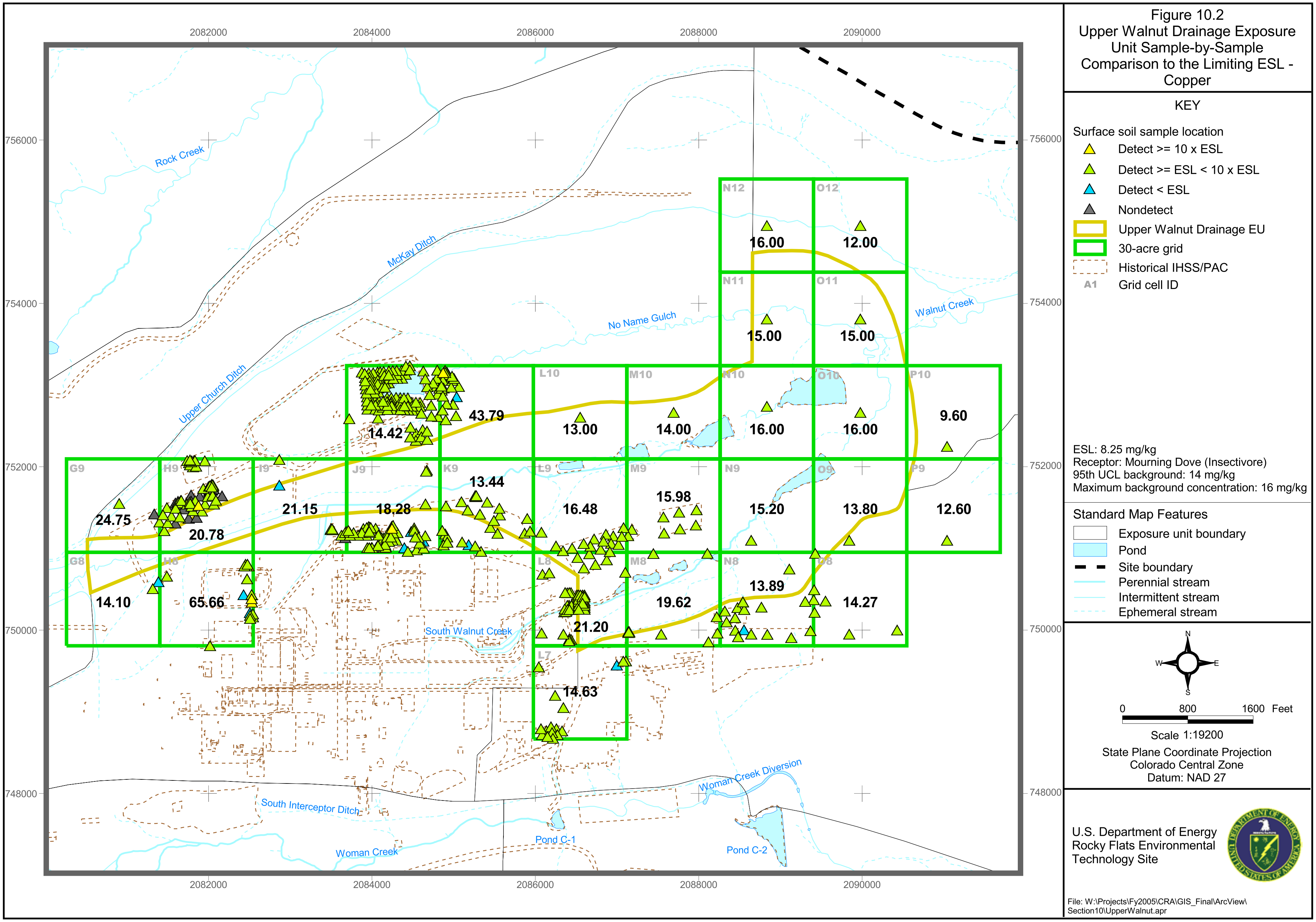

Figure 10.2
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Copper
KEY
Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Nondetect
Upper Walnut Drainage EU
30-acre grid
Historical IHSS/PAC
A1
Grid cell ID
ESL: 8.25 mg/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: 14 mg/kg
Maximum background concentration: 16 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
W
E
S
0
800
1600 Feet
Scale 1:19200
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr
2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
748000
Rock Creek
McKay Ditch
No Name Gulch
Walnut Creek
Upper Church Ditch
South Walnut Creek
South Interceptor Ditch
Woman Creek
Woman Creek Diversion
Pond C-1
Pond C-2
N12
O12
16.00
12.00
N11
O11
15.00
15.00
L10
M10
N10
O10
P10
43.79
14.42
13.00
14.00
16.00
16.00
9.60
G9
H9
I9
J9
K9
L9
M9
N9
O9
P9
24.75
20.78
21.15
18.28
13.44
16.48
15.98
15.20
13.80
12.60
G8
H8
L8
M8
N8
O8
14.10
65.66
21.20
19.62
13.89
14.27
L7
14.63

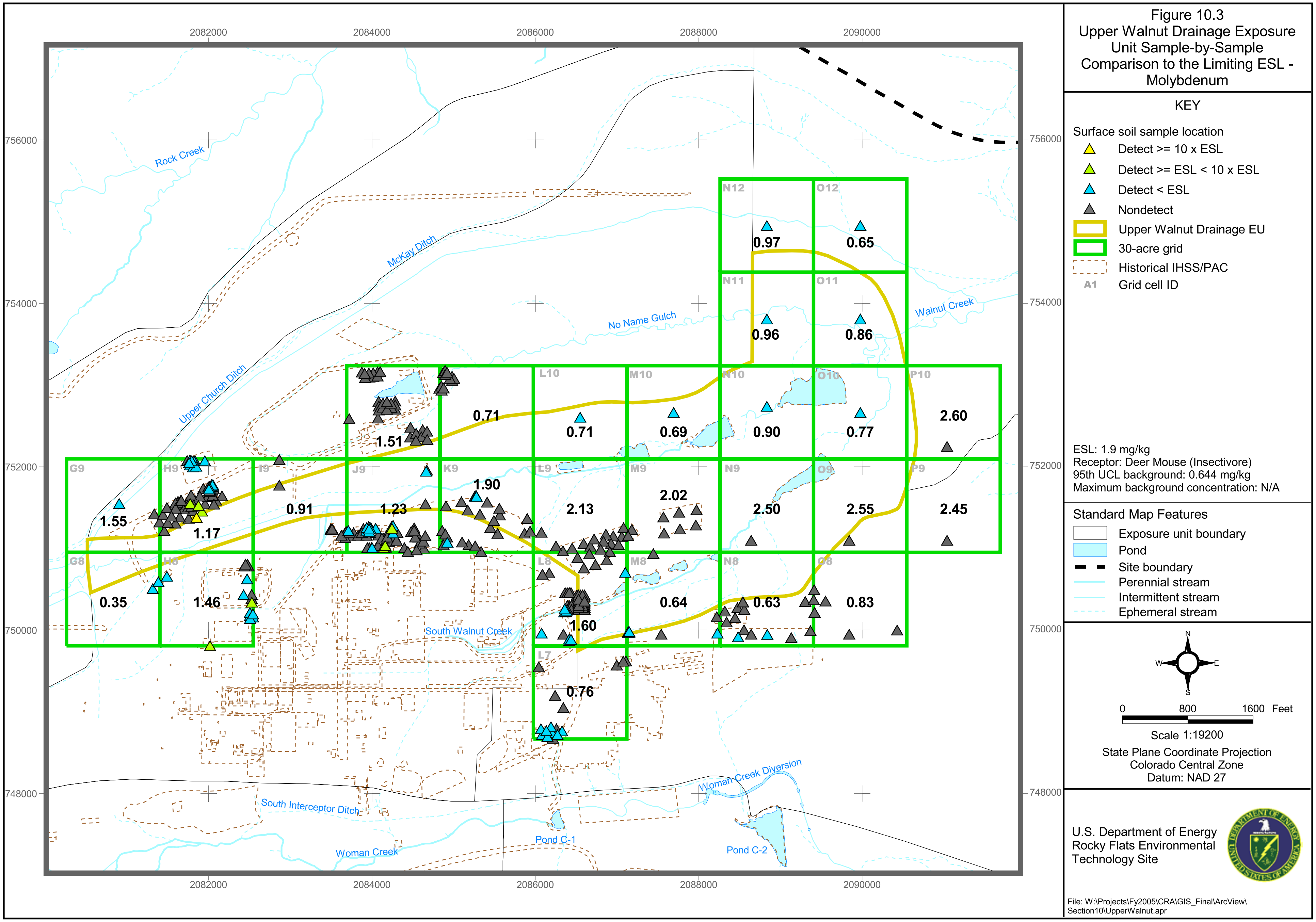

Figure 10.3
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Molybdenum

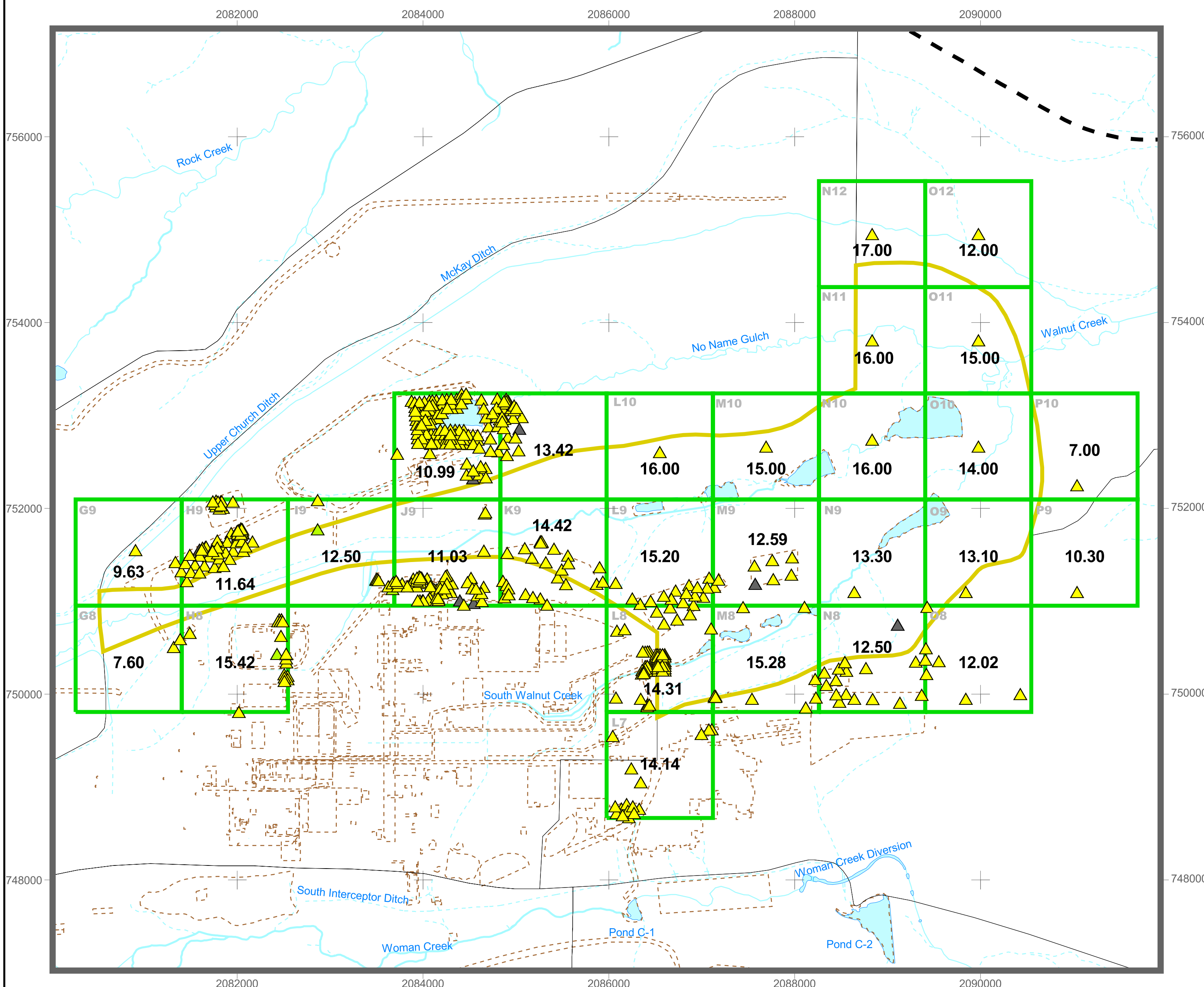

Figure 10.4
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Nickel

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.431 mg/kg
Receptor: Deer Mouse (Insectivore)
95th UCL background: 10.6 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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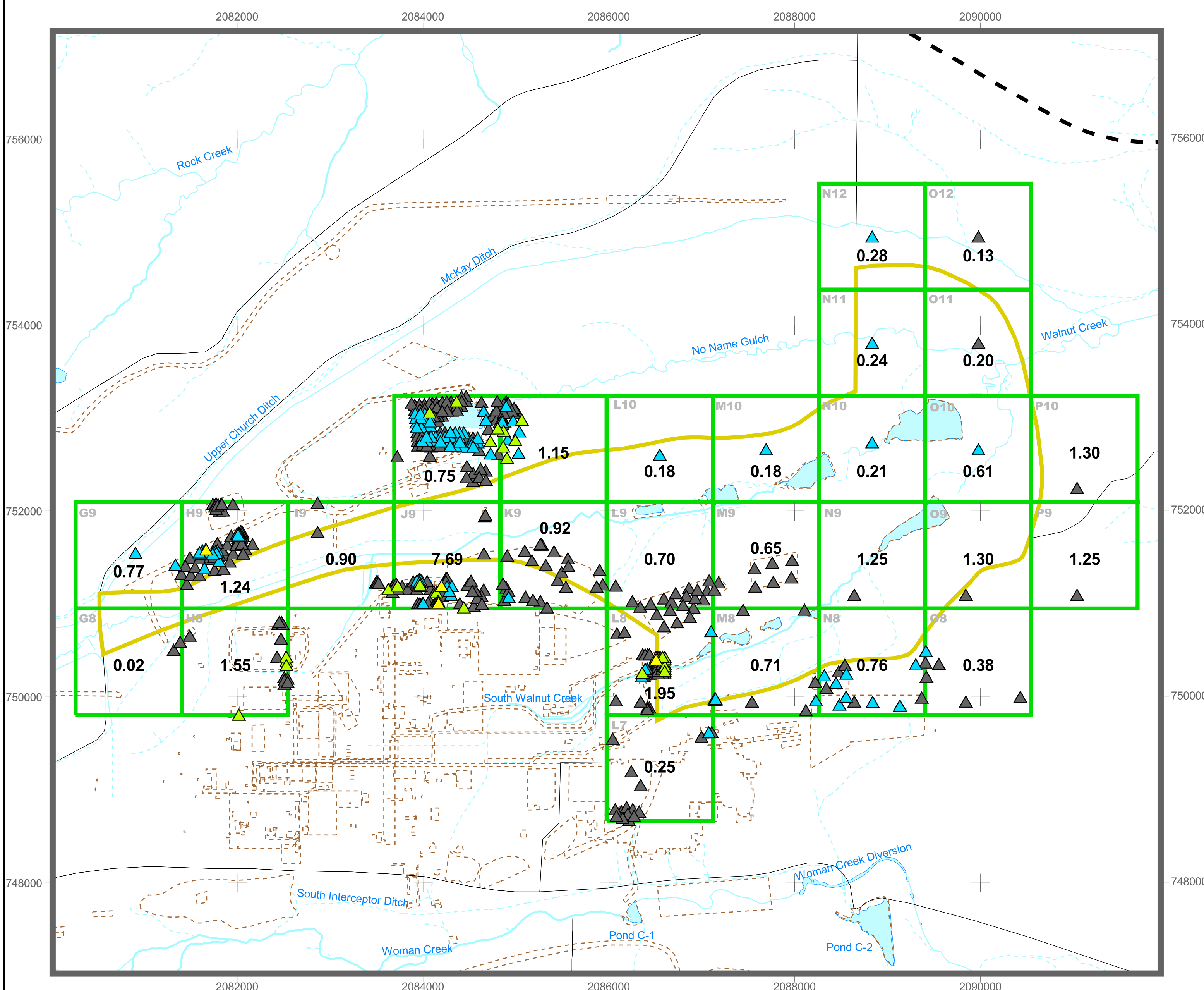
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr

Figure 10.5
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Silver



KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2 mg/kg
Receptor: Terrestrial Plants
95th UCL background: 0.21 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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W
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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr

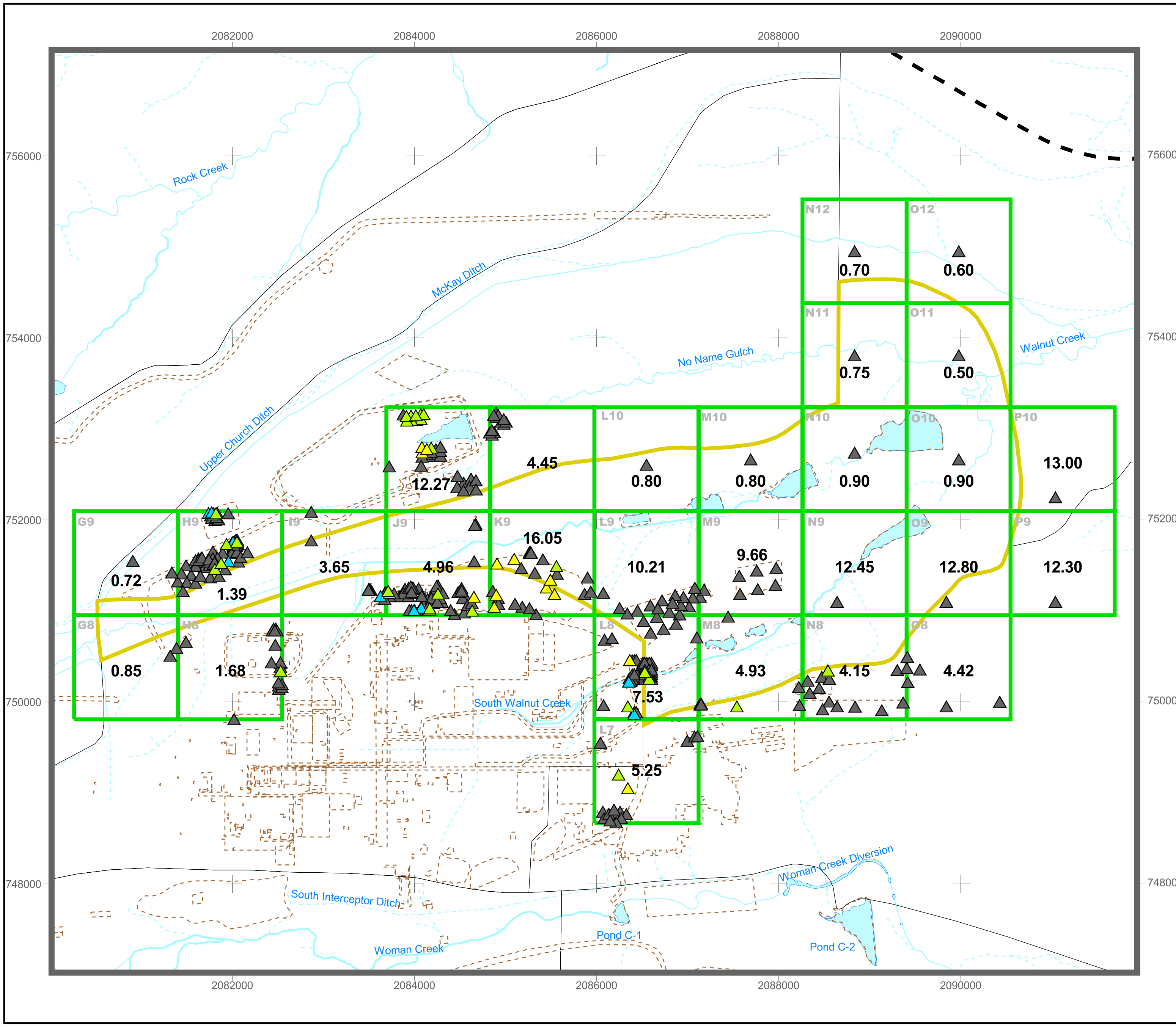

Figure 10.6
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Tin

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2.9 mg/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: 2.22 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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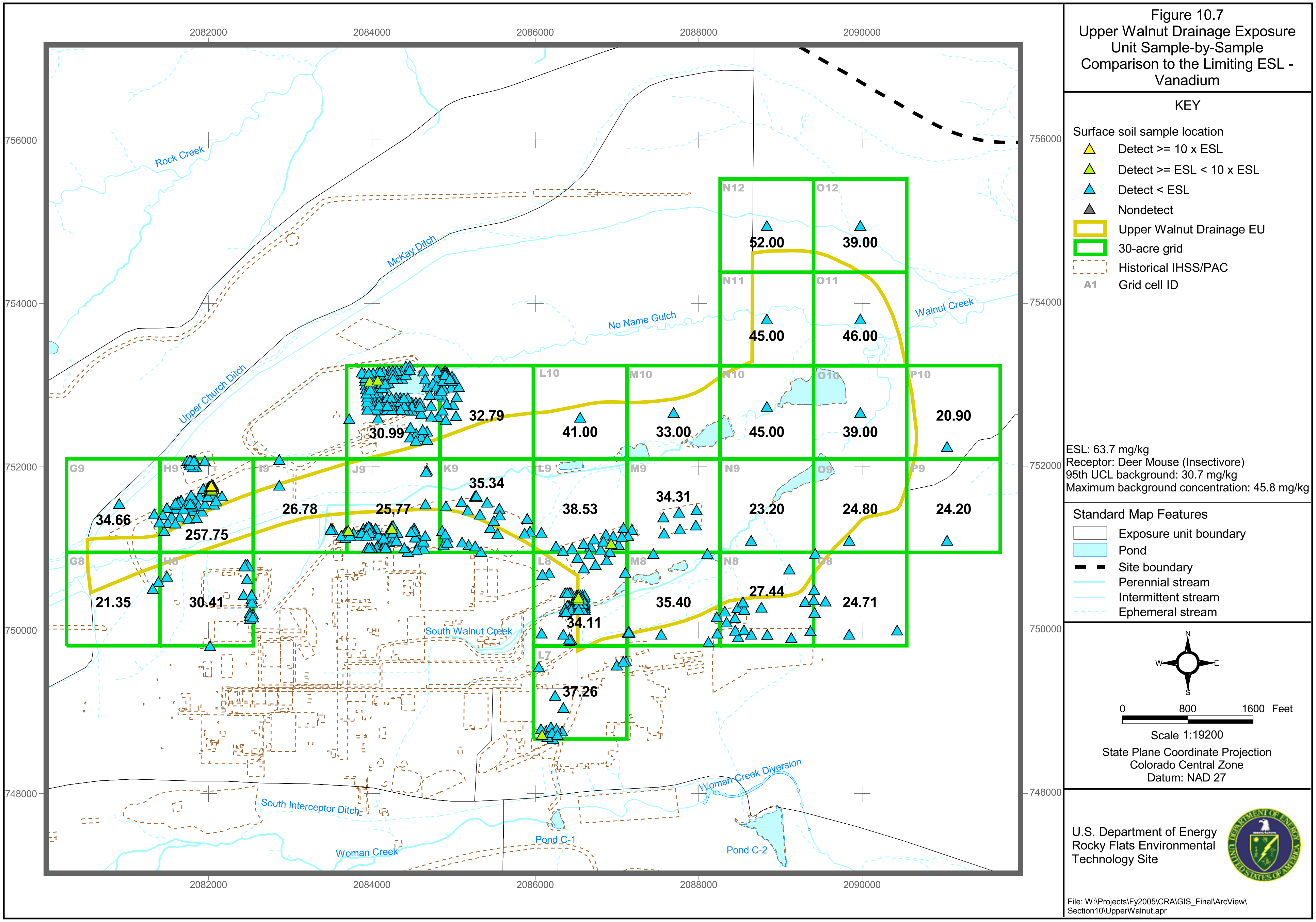
Figure 10.7
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Vanadium
KEY
Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Nondetect
Upper Walnut Drainage EU
30-acre grid
Historical IHSS/PAC
A1
Grid cell ID
ESL: 63.7 mg/kg
Receptor: Deer Mouse (Insectivore)
95th UCL background: 30.7 mg/kg
Maximum background concentration: 45.8 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
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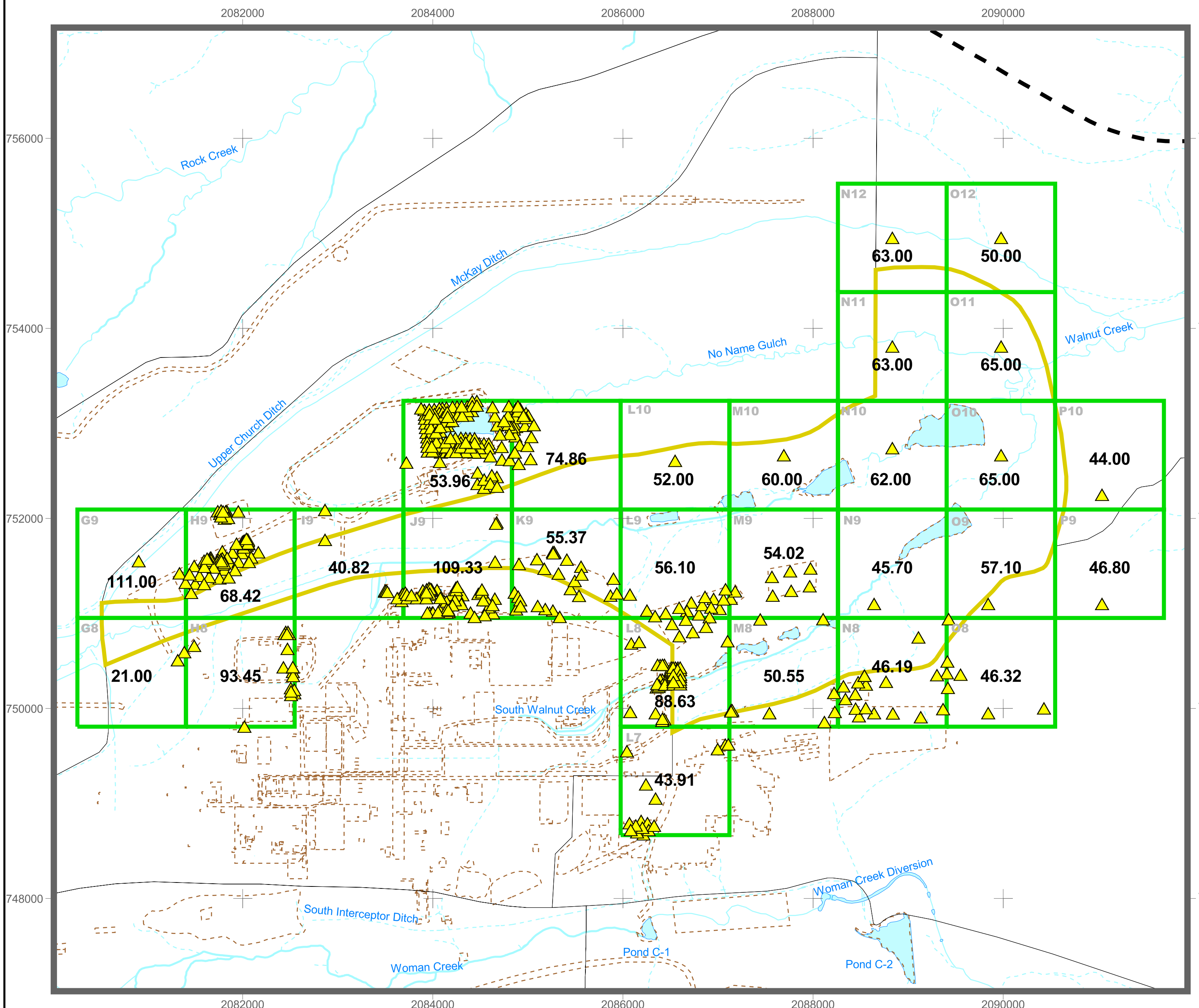
800
1600 Feet
Scale 1:19200
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr
2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
748000
Rock Creek
McKay Ditch
No Name Gulch
Walnut Creek
Upper Church Ditch
South Walnut Creek
South Interceptor Ditch
Woman Creek
Woman Creek Diversion
Pond C-1
Pond C-2
N12
O12
N11
O11
L10
M10
N10
O10
P10
G9
H9
I9
J9
K9
L9
M9
N9
O9
P9
G8
H8
L8
M8
N8
O8
L7
52.00
39.00
45.00
46.00
32.79
30.99
41.00
33.00
45.00
39.00
20.90
34.66
257.75
26.78
25.77
35.34
38.53
34.31
23.20
24.80
24.20
21.35
30.41
34.11
35.40
27.44
24.71
37.26

Figure 10.8
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Zinc



KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.646 mg/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: 54.5 mg/kg
Maximum background concentration: 75.9 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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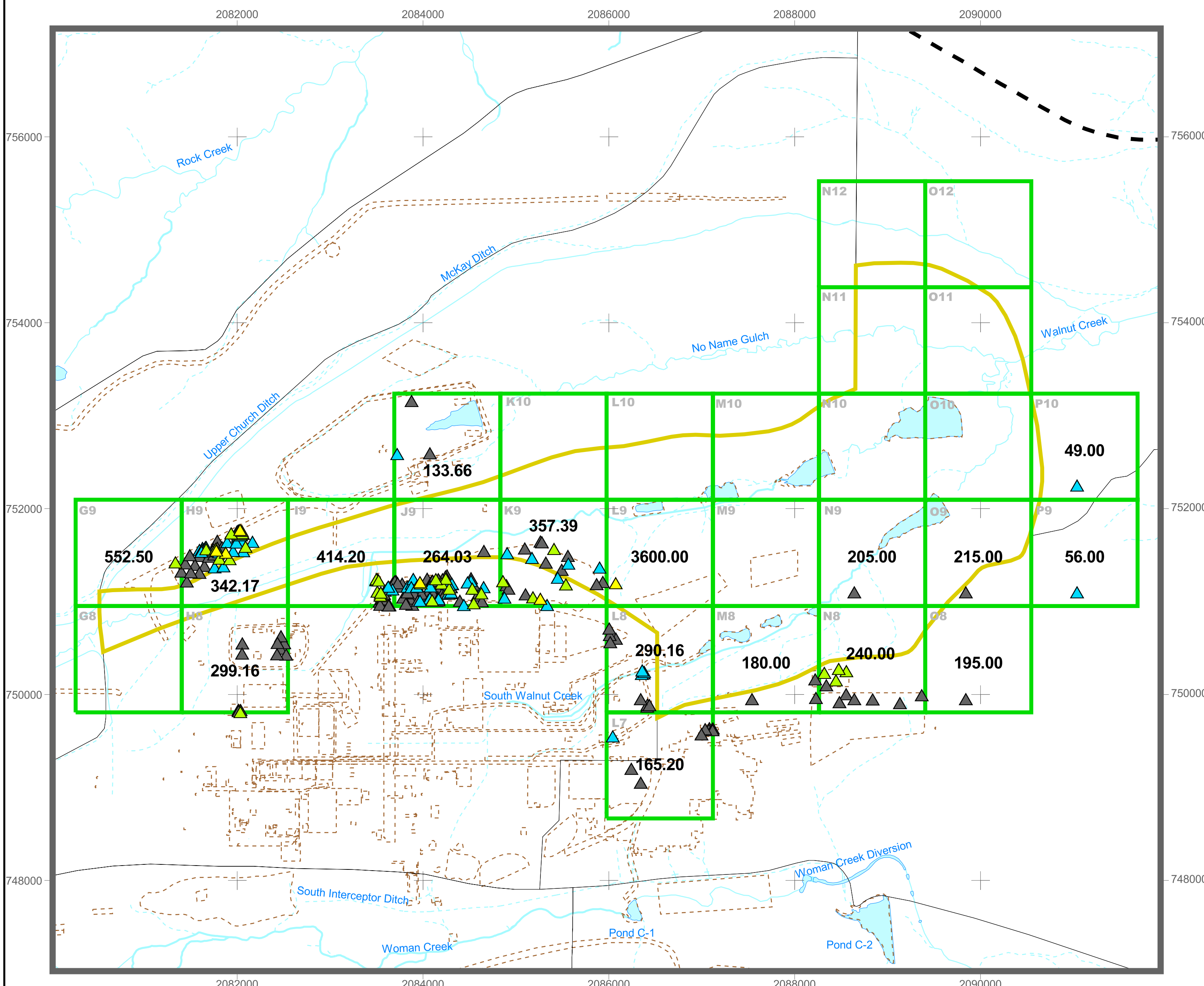

Figure 10.9
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Bis(2-ethylhexyl)phthalate

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 137 ug/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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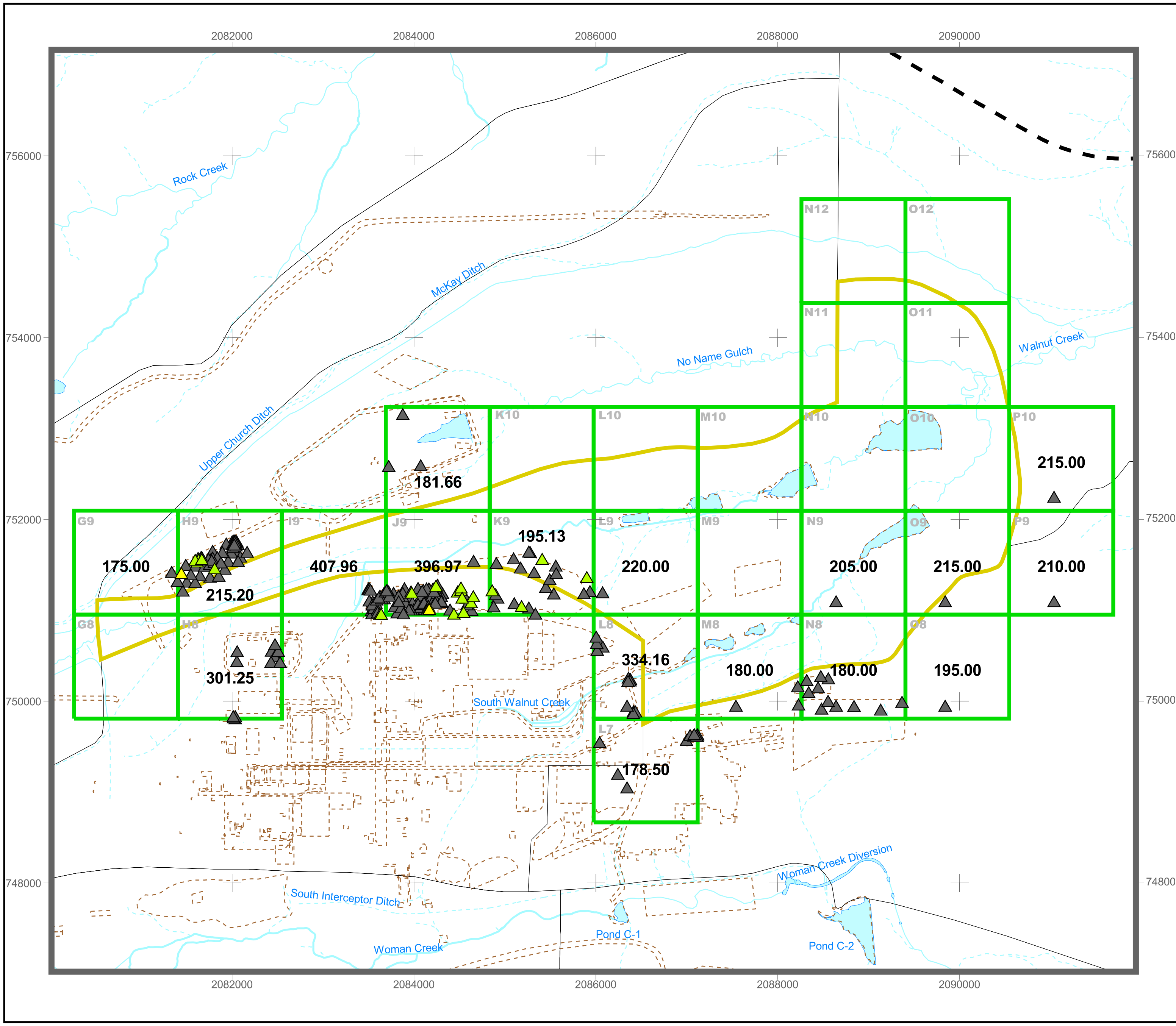

Figure 10.10
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Di-n-butylphthalate

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 15.9 ug/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S W E

0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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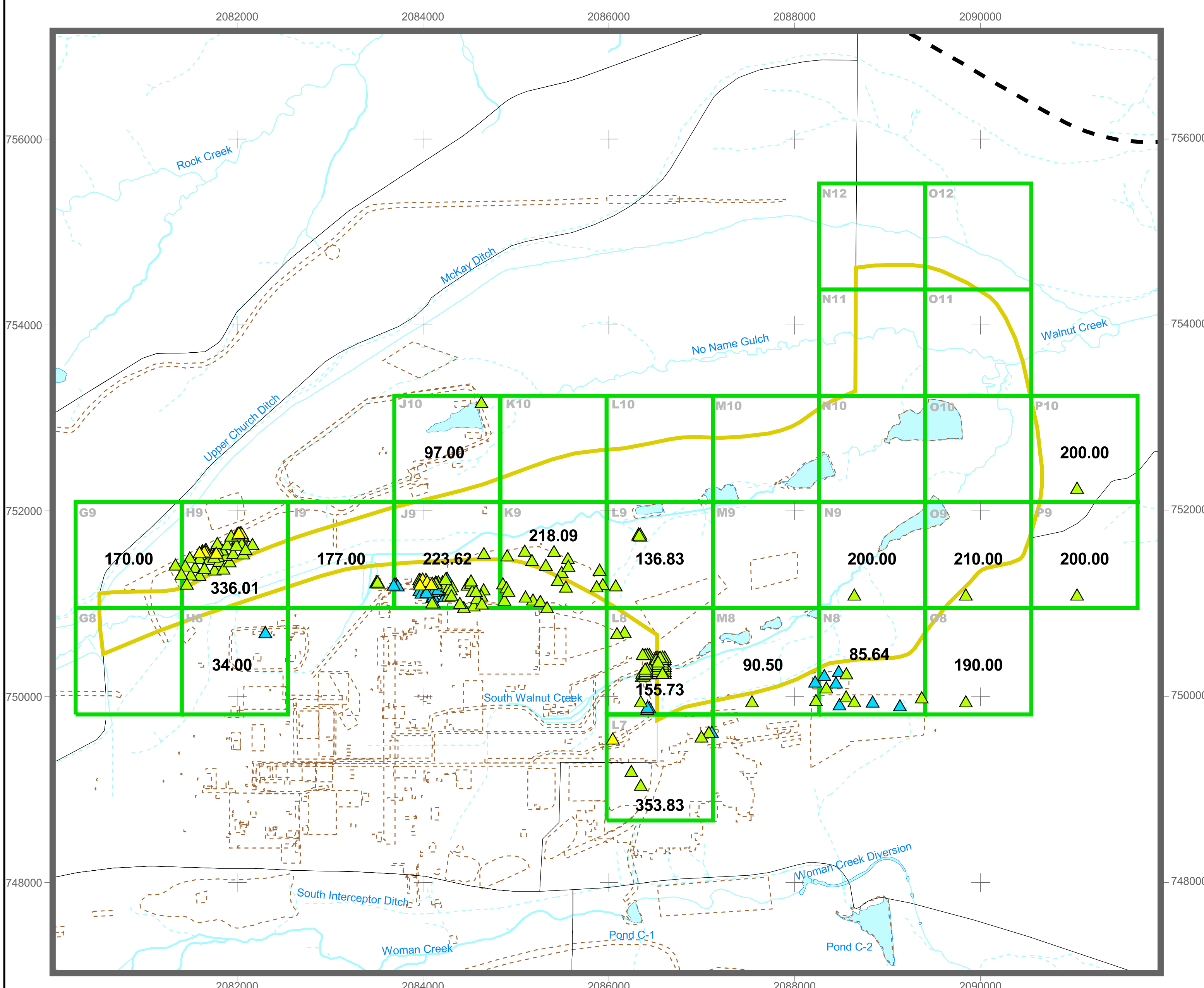
Figure 10.11
Upper Walnut Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Total PCBs



KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Upper Walnut Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 42.3 ug/kg
Receptor: Mourning Dove - (Insectivore)
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
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0 800 1600 Feet

Scale 1:19200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWalnut.apr

COMPREHENSIVE RISK ASSESSMENT

UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 1

Detection Limit Screen

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
CD	compact disc
CRA	Comprehensive Risk Assessment
ESL	ecological screening level
IHSS	Individual Hazardous Substance Site
mg/kg	milligrams per kilogram
N/A	not available or not applicable
NOAEL	no observed adverse effect level
PAC	Potential Area of Concern
pCi/g	picocuries per gram
PRG	preliminary remediation goal
TIC	tentatively identified compound
UWNEU	Upper Walnut Drainage Exposure Unit
VOC	volatile organic compound
WRW	wildlife refuge worker

1.0 EVALUATION OF ANALYTE DETECTION LIMITS FOR THE UPPER WALNUT DRAINAGE EXPOSURE ZONE AREA EXPOSURE UNIT

For the Upper Walnut Drainage Exposure Unit (EU) (UWNEU), the detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) and the minimum ecological screening levels (ESLs). The comparisons are made in the tables to this attachment for potential contaminants of concern (PCOCs) in surface soil/surface sediment and subsurface soil/subsurface sediment, and ecological contaminants of interest (ECOIs) in surface soil and subsurface soil. The percent of the samples with detection limits that exceed the PRGs and ESLs are listed in these tables. When these detection limits exceed the respective PRGs and ESLs, this is a source of uncertainty in the risk assessment process, which is discussed herein.

Laboratory reported results for “U” qualified data (nondetects) are used to perform the detection limit screen rather than the detection limit identified in the detection limit field within the Soil Water Database (SWD). The basis for the detection limit is not always certain, i.e., Instrument Detection Limit (IDL), Method Detection Limit (MDL), Reporting Limit (RL), Sample Quantitation Limit (SQL), etc. Therefore, to be consistent in reporting, the “reported results” are presented in the tables to this attachment. Also, for statistical computations and risk estimations presented in the main text and tables to this volume, one-half the reported results are used as proxy values for nondetected data.

The term analyte as used in the following sections refers to analytes that are non-detected or detected in less than 5 percent of the samples. PRGs and ESLs do not exist for some of these analytes, which is also a source of uncertainty for the risk assessment. This uncertainty is discussed in Sections 6.2.1 and 10.3.2 of the main text of this volume.

1.1 Comparison of Reported Results to Preliminary Remediation Goals

1.1.1 Surface Soil/Surface Sediment

As shown in Table A1.1, there are only five analytes in surface soil/surface sediment where the reported results exceed the PRG: 3,3’-dichlorobenzidine (3%), 4,6-dinitro-2-methylphenol (8%), dibenz(a,h)anthracene (97%), hexachlorobenzene (6%), N-nitroso-di-n-propylamine (86%), and pentachlorophenol (3%). For 3,3’-dichlorobenzidine, 4,6-dinitro-2-methylphenol, hexachlorobenzene, and pentachlorophenol greater than 90% of the reported results are less than the PRGs, which represents only minimal uncertainty in the overall risk estimates. For dibenz(a,h)anthracene and N-nitroso-di-n-propylamine, the maximum reported results are within an order of magnitude of the lowest ESLs. Therefore, the higher reported results for these two analytes also represent minimal uncertainty in the overall risk estimates.

1.1.2 Subsurface Soil/Subsurface Sediment

All reported results are below the PRGs in subsurface soil/subsurface sediment (Table A1.2).

1.2 Comparison of Reported Results to Ecological Screening Levels

1.2.1 Surface Soil

As shown in Table A1.3, there are 14 analytes in surface soil where some percent of the reported results exceed the lowest ESL. For uranium and hexachlorobutadiene, over 60% of the reported results are less than the lowest ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 12 analytes, 100% of the reported results exceed the lowest ESL, and in some cases, the maximum reported results are more than an order of magnitude higher than the lowest ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates, i.e., ecological risks may be underestimated because these analytes may have been included as ECOPCs had they been detected more frequently using lower detection limits (lower reported results).

First, for these remaining 12 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.3) are similar in magnitude to the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (330-830 ug/kg for semi-volatile organic compounds (SVOCs); 1.7-3.3 ug/kg for pesticides; and 33-67 ug/kg for PCBs depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential.

Professional judgment indicates whether the analytes are likely to be ECOPCs in the UWNEU surface soil based on 1) a listing of the analytes (or classes of analytes) as constituents in wastes potentially released at historical Individual Hazardous Substance Sites (IHSSs) in the UWNEU (DOE 2005a), 2) the historical inventory for the chemical at RFETS (CDH 1991), and 3) a comparison of the maximum detected concentration and detection frequency in the EU and sitewide surface soil (see Table A1.4 for sitewide surface soil summary statistics). The comparison of the EU and sitewide maximum detected concentrations and detection frequencies in surface soil is performed to assess if the EU observations are much higher, which may potentially also indicate a source for the analyte within the EU. Using professional judgment, the analytes can be grouped into four categories that represent an ascending order of uncertainty. Category 1 is for analytes that were not listed as waste constituents for the EU historical IHSSs, and are not detected in the EU or sitewide surface soil. Category 2 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, but nevertheless are not detected in the EU surface soil even though they were detected in other EU surface soil at RFETS at low maximum detected concentrations and low detection frequencies. Category 3 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, and are detected in the EU (and therefore sitewide) surface soil, and the maximum detected concentrations in the EU surface soil are approximately the same order of magnitude as the ESL, and the detection frequencies are low. For these first three categories, the uncertainty with regard to the risk estimates because of the higher detection limits is considered small. Category 4 is for analytes that are detected in the EU (and therefore sitewide) surface soil at maximum concentrations that substantially exceed the ESLs and at detection frequencies generally higher than for Category 3, i.e., these analytes have the highest likelihood of being ECOPCs had they been detected more frequently using lower detection limits (lower reported results), and therefore, there is some uncertainty with regard to the risk estimates because of the higher detection limits.

The assessment of the ecological risk potential compares the maximum reported result to a Lowest Observed Adverse Effect Level (LOAEL)-based soil concentration. ESLs are based on No Observed Adverse Effect Levels (NOAELs) (DOE 2005b). The LOAEL-based soil concentration is estimated by multiplying the lowest ESL by the LOAEL/NOAEL ratio for the mammal or the bird depending on whether a mammal or bird is the most sensitive terrestrial vertebrate receptor for the chemical (see Appendix B, Table B-2 of the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005b) for the Lowest Bounded LOAELs and Final NOAELs for mammals and birds). A maximum reported result/LOAEL-based soil concentration ratio greater than one indicates a potential for an adverse ecological effect if the analyte was detected at the highest reported result.

As shown in Table A1.5, all of the 12 analytes assessed using professional judgment are in categories 1 through 3, and thus are not likely to be ECOPCs in the UWNEU surface soil based on professional judgment, which minimizes the uncertainty in the overall risk estimates because of their higher reported results. Although dieldrin and pentachlorophenol were not detected in the EU surface soil, they have been classified as category 3 because of the relatively high detection of these compounds in sitewide surface soil. Nevertheless, the uncertainty associated with the category 3 analytes is considered low. Comparing the maximum reported results to the LOAEL-based soil concentrations indicates more than half of the above noted analytes would also not present a potential for adverse ecological effects if they were detected at the maximum reported results.

In conclusion, analytes in surface soil that have reported results that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the reported results are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWNEU surface soil even if detection limits had been lower. Although some of the analytes would present a potential for adverse ecological effects if they were detected at their maximum reported results, because they are not expected to be ECOPCs in UWNEU surface soil, uncertainty in the overall risk estimates is low.

1.2.2 Subsurface Soil

All reported results are below the ESLs in subsurface soil (Table A1.6).

2.0 REFERENCES

CDH, 1991. Colorado Department of Health Project Task 1 Report (Revised 1), Identification of Chemicals and Radionuclides Used at Rocky Flats. Prepared by ChemRisk. March.

DOE, 2005a, 2005 Annual Update to the Historical Release Report, Rocky Flats Environmental Technology Site, October.

DOE, 2005b. Final Comprehensive Risk Assessment Work Plan and Methodology, Revision 1, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1. September.

TABLES

Table A1.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil/Surface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Cyanide	0.560	-	0.560	1	2,222	0	0	No
Nitrite	2.50	-	2.50	3	11,109	0	0	No
Sulfate	25	-	25	3		0	0	No
Uranium	1.40	-	39	42	333	0	0	Yes
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.47	-	22	15	91,018	0	0	No
1,1,1-Trichloroethane	1.71	-	1,300	39	9.18E+06	0	0	No
1,1,2,2-Tetrachloroethane	1.47	-	1,300	38	10,483	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.90	-	22	15	2.38E+09	0	0	No
1,1,2-Trichloroethane	1.60	-	1,300	39	28,022	0	0	No
1,1-Dichloroethane	1.39	-	1,300	39	2.72E+06	0	0	No
1,1-Dichloroethene	2.08	-	1,300	38	17,366	0	0	No
1,1-Dichloropropene	1.80	-	22	15		0	0	No
1,2,3-Trichlorobenzene	1.97	-	22	13		0	0	No
1,2,3-Trichloropropane	1.73	-	22	15	2,079	0	0	No
1,2,4-Trichlorobenzene	1.91	-	3,600	76	151,360	0	0	No
1,2,4-Trimethylbenzene	1.48	-	22	13	132,620	0	0	No
1,2-Dibromo-3-chloropropane	2.91	-	22	14	2,968	0	0	No
1,2-Dibromoethane	1.74	-	22	15	35.1	0	0	No
1,2-Dichlorobenzene	1.92	-	990	63	2.89E+06	0	0	No
1,2-Dichloroethane	1.71	-	1,300	38	13,270	0	0	No
1,2-Dichloroethene	7	-	1,300	24	999,783	0	0	No
1,2-Dichloropropane	1.82	-	1,300	39	38,427	0	0	No
1,3,5-Trimethylbenzene	1.60	-	22	13	114,340	0	0	No
1,3-Dichlorobenzene	1.54	-	3,600	76	3.33E+06	0	0	No
1,3-Dichloropropane	1.63	-	22	15		0	0	No
1,4-Dichlorobenzene	1.80	-	990	63	91,315	0	0	No
1234789-HpCDF	0.00286	-	0.00286	1		0	0	No
123478-HxCDD	0.00286	-	0.00286	1	0.483	0	0	No
123678-HxCDF	0.00286	-	0.00286	1		0	0	No
123789-HxCDF	0.00286	-	0.00286	1		0	0	No
12378-PeCDF	0.00286	-	0.00286	1		0	0	No
2,2-Dichloropropane	1.80	-	22	15		0	0	No
2,4,5-Trichlorophenol	350	-	4,800	66	8.01E+06	0	0	No
2,4,6-Trichlorophenol	350	-	3,600	66	272,055	0	0	No
2,4-Dichlorophenol	350	-	3,600	66	240,431	0	0	No
2,4-Dimethylphenol	350	-	3,600	66	1.60E+06	0	0	No
2,4-Dinitrophenol	1,400	-	18,000	61	160,287	0	0	No
2,4-Dinitrotoluene	350	-	3,600	66	160,287	0	0	No
2,6-Dinitrotoluene	350	-	3,600	66	80,144	0	0	No
234678-HxCDF	0.00286	-	0.00286	1		0	0	No
23478-PeCDF	0.00286	-	0.00286	1		0	0	No
2378-TCDD	0.00114	-	0.00114	1	0.0248	0	0	No
2378-TCDF	0.00114	-	0.00114	1		0	0	No
2-Chloronaphthalene	350	-	3,600	66	6.41E+06	0	0	No
2-Chlorophenol	350	-	3,600	66	555,435	0	0	No
2-Chlorotoluene	1.54	-	22	13	2.22E+06	0	0	No
2-Hexanone	2.26	-	1,300	39		0	0	No
2-Methylnaphthalene	350	-	3,600	65	320,574	0	0	Yes
2-Methylphenol	350	-	3,600	66	4.01E+06	0	0	No
2-Nitroaniline	1,400	-	18,000	66	192,137	0	0	No
2-Nitrophenol	350	-	3,600	66		0	0	No
3,3'-Dichlorobenzidine	400	-	7,100	65	6,667	2	3.08	No
3-Nitroaniline	1,400	-	18,000	63		0	0	No
4,4'-DDD	5.40	-	120	75	15,528	0	0	No
4,4'-DDE	5.40	-	120	74	10,961	0	0	Yes
4,4'-DDT	5.40	-	120	72	10,927	0	0	Yes

Table A1.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil/Surface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
4,6-Dinitro-2-methylphenol	1,400	-	18,000	63	8,014	5	7.94	No
4-Bromophenyl-phenylether	350	-	3,600	66		0	0	No
4-Chloro-3-methylphenol	350	-	7,100	66		0	0	No
4-Chloroaniline	350	-	7,100	66	320,574	0	0	No
4-Chlorophenyl-phenyl ether	350	-	3,600	66		0	0	No
4-Chlorotoluene	1.45	-	22	13		0	0	No
4-Isopropyltoluene	1.66	-	22	13		0	0	No
4-Methyl-2-pentanone	2.67	-	1,300	39	8.32E+07	0	0	No
4-Methylphenol	350	-	3,600	66	400,718	0	0	No
4-Nitroaniline	1,400	-	18,000	66	207,917	0	0	No
4-Nitrophenol	1,400	-	18,000	66	641,148	0	0	No
Acenaphthylene	350	-	1,800	66		0	0	No
Aldrin	2.70	-	60	73	176	0	0	Yes
alpha-BHC	2.70	-	60	75	570	0	0	No
alpha-Chlordane	2.70	-	600	74	10,261	0	0	No
Benzene	1.83	-	1,300	37	23,563	0	0	Yes
Benzyl Alcohol	350	-	7,100	63	2.40E+07	0	0	No
beta-BHC	2.70	-	60	75	1,995	0	0	No
beta-Chlordane	2.70	-	240	64	10,261	0	0	No
bis(2-Chloroethoxy) methane	350	-	3,600	66		0	0	No
bis(2-Chloroethyl) ether	350	-	3,600	66	3,767	0	0	No
bis(2-Chloroisopropyl) ether	350	-	3,600	66	59,301	0	0	No
Bromobenzene	1.64	-	22	13		0	0	No
Bromochloromethane	2	-	22	15		0	0	No
Bromodichloromethane	1.98	-	1,300	39	67,070	0	0	No
Bromoform	1.71	-	1,300	39	419,858	0	0	No
Bromomethane	1.70	-	1,300	39	20,959	0	0	No
Butylbenzylphthalate	350	-	3,600	64	1.60E+07	0	0	Yes
Carbon Disulfide	1.31	-	1,300	39	1.64E+06	0	0	No
Chlordane	94	-	94	1	10,261	0	0	No
Chlorobenzene	1.47	-	1,300	38	666,523	0	0	No
Chloroethane	2.38	-	1,300	39	1.43E+06	0	0	No
Chloroform	1.47	-	1,300	39	7,850	0	0	No
Chloromethane	2.56	-	1,300	39	115,077	0	0	No
cis-1,2-Dichloroethene	5	-	11	15	1.11E+06	0	0	No
cis-1,3-Dichloropropene	1.77	-	1,300	39	19,432	0	0	No
delta-BHC	2.70	-	60	74	570	0	0	Yes
Dibenz(a,h)anthracene	350	-	3,600	64	379	62	96.9	Yes
Dibenzofuran	350	-	3,600	64	222,174	0	0	Yes
Dibromochloromethane	1.87	-	1,300	39	49,504	0	0	No
Dibromomethane	2.11	-	22	15		0	0	No
Dichlorodifluoromethane	2.46	-	22	15	229,820	0	0	No
Dieldrin	5.40	-	120	74	187	0	0	Yes
Diethylphthalate	370	-	3,600	66	6.41E+07	0	0	No
Dimethylphthalate	350	-	3,600	66	8.01E+08	0	0	No
Di-n-octylphthalate	350	-	3,600	65	3.21E+06	0	0	Yes
Endosulfan I	2.70	-	24	74	480,861	0	0	Yes
Endosulfan II	5.40	-	120	75	480,861	0	0	No
Endosulfan sulfate	5.40	-	120	75	480,861	0	0	No
Endrin	5.40	-	120	75	24,043	0	0	No
Endrin aldehyde	5.40	-	17	4	24,043	0	0	No
Endrin ketone	5.40	-	120	74	33,326	0	0	No
Ethylbenzene	1.61	-	1,300	39	5.39E+06	0	0	No
gamma-BHC (Lindane)	2.70	-	60	75	2,771	0	0	No
gamma-Chlordane	110	-	600	10	10,261	0	0	No
Heptachlor	2.70	-	60	75	665	0	0	No
Heptachlor epoxide	2.70	-	60	75	329	0	0	No
Hexachlorobenzene	350	-	3,600	66	1,870	4	6.06	No

Table A1.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil/Surface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Hexachlorobutadiene	2	-	3,600	77	22,217	0	0	No
Hexachlorocyclopentadiene	370	-	3,600	64	380,452	0	0	No
Hexachloroethane	350	-	3,600	66	111,087	0	0	No
Isophorone	350	-	3,600	66	3.16E+06	0	0	No
Isopropylbenzene	1.47	-	22	13	32,680	0	0	No
Methoxychlor	27	-	600	74	400,718	0	0	Yes
Naphthalene	1.87	-	3,600	74	1.40E+06	0	0	Yes
n-Butylbenzene	1.68	-	22	13		0	0	No
Nitrobenzene	350	-	3,600	66	43,246	0	0	No
N-Nitroso-di-n-propylamine	350	-	3,600	66	429	57	86.4	No
N-nitrosodiphenylamine	350	-	3,600	66	612,250	0	0	No
n-Propylbenzene	1.50	-	22	13		0	0	No
PCB-1016	35	-	600	120	1,349	0	0	No
PCB-1221	35	-	600	120	1,349	0	0	No
PCB-1232	35	-	600	120	1,349	0	0	No
PCB-1242	35	-	600	120	1,349	0	0	No
PCB-1248	35	-	600	120	1,349	0	0	No
PCB-1260	35	-	1,200	115	1,349	0	0	Yes
Pentachlorodibenzo-p-dioxin	0.00286	-	0.00286	1		0	0	No
Pentachlorophenol	1,400	-	18,000	66	17,633	2	3.03	No
Phenol	350	-	3,600	66	2.40E+07	0	0	No
Pyridine	700	-	3,600	14		0	0	No
sec-Butylbenzene	1.71	-	22	13		0	0	No
Styrene	1.42	-	1,300	39	1.38E+07	0	0	No
tert-Butylbenzene	1.39	-	22	13		0	0	No
Toxaphene	160	-	1,200	75	2,720	0	0	No
trans-1,2-Dichloroethene	1.99	-	11	15	287,340	0	0	No
trans-1,3-Dichloropropene	1.67	-	1,300	39	20,820	0	0	No
Vinyl acetate	13	-	33	18	2.65E+06	0	0	No
Vinyl Chloride	2.42	-	1,300	39	2,169	0	0	No
Xylene	2.83	-	1,300	39	1.06E+06	0	0	No

Table A1.2
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Cyanide	0.504	-	5	12	25550	0	0	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.36	-	23	25	1.05E+06	0	0	No
1,1,1-Trichloroethane	1.09	-	1,600	172	1.06E+08	0	0	Yes
1,1,2,2-Tetrachloroethane	1.42	-	1,600	176	120,551	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	2.21	-	23	25	2.74E+10	0	0	No
1,1,2-Trichloroethane	0.970	-	1,600	176	322,253	0	0	No
1,1-Dichloroethane	0.773	-	1,600	176	3.12E+07	0	0	No
1,1-Dichloroethene	1.54	-	1,600	175	199,706	0	0	Yes
1,1-Dichloropropene	1.15	-	23	25		0	0	No
1,2,3-Trichlorobenzene	1.69	-	23	24		0	0	Yes
1,2,3-Trichloropropane	1.35	-	23	25	23,910	0	0	No
1,2,4-Trichlorobenzene	1.70	-	2,800	73	1.74E+06	0	0	Yes
1,2,4-Trimethylbenzene	0.720	-	23	24	1.53E+06	0	0	Yes
1,2-Dibromo-3-chloropropane	3.16	-	23	25	34,137	0	0	No
1,2-Dibromoethane	1.32	-	23	25	403	0	0	No
1,2-Dichlorobenzene	1.52	-	780	63	3.32E+07	0	0	No
1,2-Dichloroethane	1.33	-	1,600	174	152,603	0	0	No
1,2-Dichloroethene	5	-	1,600	148	1.15E+07	0	0	Yes
1,2-Dichloropropane	1.08	-	1,600	176	441,907	0	0	No
1,3,5-Trimethylbenzene	0.836	-	23	25	1.31E+06	0	0	No
1,3-Dichlorobenzene	1.67	-	2,800	74	3.83E+07	0	0	No
1,3-Dichloropropane	0.935	-	23	25		0	0	No
1,4-Dichlorobenzene	1.23	-	780	63	1.05E+06	0	0	No
1,4-Dioxane	500	-	500	1	4.35E+06	0	0	No
2,2-Dichloropropane	1.24	-	23	25		0	0	No
2,4,5-Trichlorophenol	330	-	3,800	62	9.22E+07	0	0	No
2,4,6-Trichlorophenol	330	-	3,000	62	3.13E+06	0	0	No
2,4-Dichlorophenol	380	-	3,000	61	2.76E+06	0	0	No
2,4-Dimethylphenol	380	-	3,000	61	1.84E+07	0	0	No
2,4-Dinitrophenol	1,800	-	15,000	59	1.84E+06	0	0	No
2,4-Dinitrotoluene	330	-	3,000	63	1.84E+06	0	0	No
2,6-Dinitrotoluene	380	-	3,000	62	921,651	0	0	No
2-Chloronaphthalene	380	-	3,000	62	7.37E+07	0	0	No
2-Chlorophenol	380	-	3,000	61	6.39E+06	0	0	No
2-Chlorotoluene	0.985	-	23	25	2.56E+07	0	0	No
2-Hexanone	6	-	3,100	168		0	0	Yes
2-Methyl-1-propanol	100	-	100	1	3.83E+08	0	0	No
2-Methylnaphthalene	380	-	3,000	62	3.69E+06	0	0	No
2-Methylphenol	330	-	3,000	62	4.61E+07	0	0	No
2-Nitroaniline	1,800	-	15,000	62	2.21E+06	0	0	No
2-Nitrophenol	380	-	3,000	61		0	0	No
3,3'-Dichlorobenzidine	750	-	6,000	62	76,667	0	0	No
3-Nitroaniline	1,800	-	15,000	52		0	0	No
4,4'-DDD	18	-	42	41	178,570	0	0	No
4,4'-DDE	18	-	42	41	126,049	0	0	No
4,4'-DDT	18	-	42	41	125,658	0	0	No
4,6-Dinitro-2-methylphenol	1,800	-	15,000	60	92,165	0	0	No
4-Bromophenyl-phenylether	380	-	3,000	62		0	0	No
4-Chloro-3-methylphenol	380	-	6,000	61		0	0	No
4-Chloroaniline	380	-	6,000	56	3.69E+06	0	0	No
4-Chlorophenyl-phenyl ether	380	-	3,000	62		0	0	No

Table A1.2
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
4-Chlorotoluene	1.04	-	23	25		0	0	No
4-Isopropyltoluene	1.43	-	23	25		0	0	No
4-Methyl-2-pentanone	6	-	3,100	164	9.57E+08	0	0	Yes
4-Methylphenol	330	-	3,000	62	4.61E+06	0	0	No
4-Nitroaniline	1,800	-	15,000	62	2.39E+06	0	0	No
4-Nitrophenol	1,800	-	15,000	61	7.37E+06	0	0	No
Acenaphthene	360	-	1,500	61	5.10E+07	0	0	Yes
Acenaphthylene	360	-	1,500	62		0	0	No
Acetonitrile	100	-	100	1		0	0	No
Aldrin	9.20	-	23	41	2,024	0	0	No
alpha-BHC	9.20	-	23	41	6,555	0	0	No
alpha-Chlordane	92	-	210	40	117,997	0	0	No
Ametryne	50	-	50	2		0	0	No
Atraton	50	-	50	2		0	0	No
Benzene	1.02	-	1,600	176	270,977	0	0	No
Benzyl Alcohol	380	-	6,000	62	2.76E+08	0	0	No
beta-BHC	9.20	-	23	41	22,942	0	0	No
beta-Chlordane	92	-	210	39	117,997	0	0	No
bis(2-Chloroethoxy) methane	380	-	3,000	62		0	0	No
bis(2-Chloroethyl) ether	380	-	3,000	62	43,315	0	0	No
bis(2-Chloroisopropyl) ether	380	-	3,000	62	681,967	0	0	No
Bromobenzene	1.54	-	23	25		0	0	No
Bromochloromethane	1.48	-	23	25		0	0	No
Bromodichloromethane	1.07	-	1,600	176	771,304	0	0	No
Bromoform	0.668	-	1,600	175	4.83E+06	0	0	No
Bromomethane	2.83	-	3,100	171	241,033	0	0	No
Butylbenzylphthalate	380	-	3,000	59	1.84E+08	0	0	Yes
Carbon Disulfide	3.06	-	1,600	173	1.88E+07	0	0	Yes
Carbon Tetrachloride	1.07	-	1,600	169	97,124	0	0	Yes
Chlordane	23	-	23	1	117,997	0	0	No
Chlorobenzene	1.48	-	1,600	175	7.67E+06	0	0	Yes
Chloroethane	1.68	-	3,100	174	1.65E+07	0	0	No
Chloromethane	1.26	-	3,100	175	1.32E+06	0	0	No
cis-1,2-Dichloroethene	2.60	-	12	24	1.28E+07	0	0	Yes
cis-1,3-Dichloropropene	0.814	-	1,600	176	223,462	0	0	No
delta-BHC	9.20	-	23	41	6,555	0	0	No
Dibenz(a,h)anthracene	380	-	3,000	61	4,362	0	0	Yes
Dibenzofuran	380	-	3,000	62	2.56E+06	0	0	No
Dibromochloromethane	1.18	-	1,600	176	569,296	0	0	No
Dibromomethane	1.30	-	23	25		0	0	No
Dichlorodifluoromethane	3.19	-	23	25	2.64E+06	0	0	No
Dieldrin	18	-	42	41	2,151	0	0	No
Diethylphthalate	380	-	3,000	62	7.37E+08	0	0	No
Dimethylphthalate	380	-	3,000	62	9.22E+09	0	0	No
Endosulfan I	9.20	-	23	41	5.53E+06	0	0	No
Endosulfan II	18	-	42	41	5.53E+06	0	0	No
Endosulfan sulfate	18	-	42	41	5.53E+06	0	0	No
Endrin	18	-	42	41	276,495	0	0	No
Endrin aldehyde	23	-	23	1	276,495	0	0	No
Endrin ketone	18	-	42	41	383,250	0	0	No
Ether	10	-	10	1	2.56E+08	0	0	No
ethyl acetate	10	-	10	1	1.15E+09	0	0	No
Ethylbenzene	1.02	-	1,600	176	6.19E+07	0	0	No

Table A1.2
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Fluorene	380	-	3,000	62	3.69E+07	0	0	No
gamma-BHC (Lindane)	9.20	-	23	39	31,864	0	0	Yes
gamma-Chlordane	92	-	92	1	117,997	0	0	No
Heptachlor	9.20	-	23	41	7,647	0	0	No
Heptachlor epoxide	9.20	-	89	41	3,782	0	0	No
Hexachlorobenzene	330	-	3,000	63	21,508	0	0	No
Hexachlorobutadiene	1.79	-	2,800	74	255,500	0	0	No
Hexachlorocyclopentadiene	380	-	3,000	62	4.38E+06	0	0	No
Hexachloroethane	330	-	3,000	63	1.28E+06	0	0	No
Isophorone	380	-	3,000	62	3.63E+07	0	0	No
Isopropylbenzene	1.28	-	23	25	375,823	0	0	No
Methoxychlor	44	-	210	41	4.61E+06	0	0	No
Naphthalene	1.59	-	2,800	72	1.61E+07	0	0	Yes
n-Butanol	100	-	100	1		0	0	No
n-Butylbenzene	1.15	-	23	24		0	0	Yes
Nitrobenzene	330	-	3,000	63	497,333	0	0	No
N-Nitroso-di-n-propylamine	380	-	3,000	62	4,929	0	0	No
N-nitrosodiphenylamine	380	-	3,000	62	7.04E+06	0	0	No
n-Propylbenzene	0.972	-	23	25		0	0	No
PCB-1016	36	-	520	65	15,514	0	0	No
PCB-1221	36	-	520	65	15,514	0	0	No
PCB-1232	36	-	520	65	15,514	0	0	No
PCB-1242	36	-	520	65	15,514	0	0	No
PCB-1248	36	-	520	65	15,514	0	0	No
PCB-1260	36	-	520	64	15,514	0	0	Yes
Pentachlorodibenzo-p-dioxin	0.00135	-	0.00474	8		0	0	No
Pentachlorophenol	330	-	15,000	62	202,777	0	0	No
Phenol	380	-	3,000	60	2.76E+08	0	0	Yes
Prometon	50	-	50	2		0	0	No
Prometryn	50	-	50	2		0	0	No
Propazine	50	-	50	2		0	0	No
Pyridine	660	-	3,000	25		0	0	No
sec-Butylbenzene	1.22	-	23	25		0	0	No
Simazine	50	-	50	2	287,502	0	0	No
Simetryn	50	-	50	2		0	0	No
Styrene	0.874	-	1,600	176	1.59E+08	0	0	No
Terbutryn	50	-	50	2		0	0	No
Terbutylazine	50	-	50	2		0	0	No
tert-Butylbenzene	1.05	-	23	25		0	0	No
Toxaphene	180	-	2,300	41	31,284	0	0	No
trans-1,2-Dichloroethene	2.60	-	12	24	3.30E+06	0	0	Yes
trans-1,3-Dichloropropene	1.16	-	1,600	176	239,434	0	0	No
Vinyl acetate	10	-	1,500	145	3.04E+07	0	0	No
Vinyl Chloride	5.10	-	3,100	175	24,948	0	0	Yes
Xylene	3.05	-	1,600	175	1.22E+07	0	0	Yes

Table A1.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Chromium VI	1	-	1	1	1.34	0	0	No
Cyanide	0.560	-	0.560	1	607	0	0	No
Uranium	1.40	-	5.10	19	5	1	5.26	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.47	-	6	13		0	0	No
1,1,1-Trichloroethane	1.71	-	13	14	551,453	0	0	No
1,1,2,2-Tetrachloroethane	1.47	-	13	13	60,701	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.90	-	6	13		0	0	No
1,1,2-Trichloroethane	1.60	-	13	14		0	0	No
1,1-Dichloroethane	1.39	-	13	14	3,121	0	0	No
1,1-Dichloroethene	2.08	-	13	14	16,909	0	0	No
1,1-Dichloropropene	1.80	-	6	13		0	0	No
1,2,3-Trichlorobenzene	1.97	-	6	11		0	0	No
1,2,3-Trichloropropane	1.73	-	6	13	13,883	0	0	No
1,2,4-Trichlorobenzene	1.91	-	480	26	777	0	0	No
1,2,4-Trimethylbenzene	1.48	-	6	11		0	0	No
1,2-Dibromo-3-chloropropane	2.91	-	6	12		0	0	No
1,2-Dibromoethane	1.74	-	6	13		0	0	No
1,2-Dichlorobenzene	1.92	-	480	26		0	0	No
1,2-Dichloroethane	1.71	-	13	13	2,764	0	0	No
1,2-Dichloroethene	13	-	13	1	25,617	0	0	No
1,2-Dichloropropane	1.82	-	13	14	49,910	0	0	No
1,3,5-Trimethylbenzene	1.60	-	6	11	7,598	0	0	No
1,3-Dichlorobenzene	1.54	-	480	26		0	0	No
1,3-Dichloropropane	1.63	-	6	13		0	0	No
1,4-Dichlorobenzene	1.80	-	480	26	20,000	0	0	No
2,2-Dichloropropane	1.80	-	6	13		0	0	No
2,4,5-Trichlorophenol	1,800	-	2,400	17	4,000	0	0	No
2,4,6-Trichlorophenol	370	-	480	17	161	17	100	No
2,4-Dichlorophenol	370	-	480	17	2,744	0	0	No
2,4-Dimethylphenol	370	-	480	17		0	0	No
2,4-Dinitrophenol	1,800	-	2,400	17	20,000	0	0	No
2,4-Dinitrotoluene	370	-	480	17	32.1	17	100	No
2,6-Dinitrotoluene	370	-	480	17	6,186	0	0	No
2-Butanone	4.19	-	26	14	1.07E+06	0	0	No
2-Chloronaphthalene	370	-	480	17		0	0	No
2-Chlorophenol	370	-	480	17	281	17	100	No
2-Chlorotoluene	1.54	-	6	11		0	0	No
2-Hexanone	2.26	-	26	14		0	0	No
2-Methylnaphthalene	370	-	480	17	2,769	0	0	No
2-Methylphenol	370	-	480	17	123,842	0	0	No
2-Nitroaniline	1,800	-	2,400	17	5,659	0	0	No
2-Nitrophenol	370	-	480	17		0	0	No
3,3'-Dichlorobenzidine	400	-	970	17		0	0	No
3-Nitroaniline	1,800	-	2,400	17		0	0	No
4,4'-DDD	16	-	23	39	13,726	0	0	No
4,4'-DDE	16	-	23	39	7.95	39	100	No
4,4'-DDT	16	-	23	39	1.20	39	100	No
4,6-Dinitro-2-methylphenol	1,800	-	2,400	17	560	17	100	No
4-Bromophenyl-phenylether	370	-	480	17		0	0	No
4-Chloro-3-methylphenol	370	-	480	17		0	0	No
4-Chloroaniline	370	-	480	17	716	0	0	No
4-Chlorophenyl-phenyl ether	370	-	480	17		0	0	No
4-Chlorotoluene	1.45	-	6	11		0	0	No
4-Isopropyltoluene	1.66	-	6	11		0	0	No
4-Methyl-2-pentanone	2.67	-	26	14	14,630	0	0	No
4-Methylphenol	370	-	480	17		0	0	No

Table A1.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
4-Nitroaniline	1,800	-	2,400	17	41,050	0	0	No
4-Nitrophenol	1,800	-	2,400	17	7,000	0	0	No
Acenaphthene	370	-	480	17	20,000	0	0	No
Acenaphthylene	370	-	480	17		0	0	No
Aldrin	8.10	-	12	39	47.0	0	0	No
alpha-BHC	8.10	-	12	39	18,662	0	0	No
alpha-Chlordane	81	-	120	39	289	0	0	No
Anthracene	370	-	480	17		0	0	No
Benzene	1.83	-	13	14	500	0	0	No
Benzyl Alcohol	370	-	480	17	4,403	0	0	No
beta-BHC	8.10	-	12	39	207	0	0	No
beta-Chlordane	81	-	120	39	289	0	0	No
bis(2-Chloroethoxy) methane	370	-	480	17		0	0	No
bis(2-Chloroethyl) ether	370	-	480	17		0	0	No
bis(2-Chloroisopropyl) ether	370	-	480	17		0	0	No
Bromobenzene	1.64	-	6	11		0	0	No
Bromochloromethane	2	-	6	13		0	0	No
Bromodichloromethane	1.98	-	13	14	5,750	0	0	No
Bromoform	1.71	-	13	14	2,855	0	0	No
Bromomethane	1.70	-	26	14		0	0	No
Carbon Disulfide	1.31	-	13	14	5,676	0	0	No
Carbon Tetrachloride	1.83	-	13	14	8,906	0	0	No
Chlorobenzene	1.47	-	13	14	4,750	0	0	No
Chloroethane	2.38	-	26	14		0	0	No
Chloroform	1.47	-	13	14	8,655	0	0	No
Chloromethane	2.56	-	26	14		0	0	No
cis-1,2-Dichloroethene	5	-	6	13	1,814	0	0	No
cis-1,3-Dichloropropene	1.77	-	13	14	2,800	0	0	No
delta-BHC	8.10	-	12	39	25.9	0	0	No
Dibenz(a,h)anthracene	370	-	480	17		0	0	No
Dibenzofuran	370	-	480	17	21,200	0	0	No
Dibromochloromethane	1.87	-	13	14	5,730	0	0	No
Dibromomethane	2.11	-	6	13		0	0	No
Dichlorodifluoromethane	2.46	-	13	13	855	0	0	No
Dieldrin	16	-	23	39	7.40	39	100	No
Diethylphthalate	370	-	480	17	100,000	0	0	No
Dimethylphthalate	370	-	480	17	200,000	0	0	No
Endosulfan I	8.10	-	12	39	80.1	0	0	No
Endosulfan II	16	-	23	39	80.1	0	0	No
Endosulfan sulfate	16	-	23	39	80.1	0	0	No
Endrin	16	-	23	39	1.40	39	100	No
Endrin ketone	16	-	23	39	1.40	39	100	No
Ethylbenzene	1.61	-	13	14		0	0	No
Fluorene	370	-	480	17	30,000	0	0	No
gamma-BHC (Lindane)	8.10	-	12	39	25.9	0	0	No
Heptachlor	8.10	-	12	39	63.3	0	0	No
Heptachlor epoxide	8.10	-	12	39	64.0	0	0	No
Hexachlorobenzene	370	-	480	17	7.73	17	100	No
Hexachlorobutadiene	2	-	480	27	431	10	37.0	No
Hexachlorocyclopentadiene	370	-	480	17	5,518	0	0	No
Hexachloroethane	370	-	480	17	366	17	100	No
Isophorone	370	-	480	17		0	0	No
Isopropylbenzene	1.47	-	6	11		0	0	No
Methoxychlor	81	-	120	39	1,226	0	0	No
Naphthalene	1.87	-	480	26	27,048	0	0	No
n-Butylbenzene	1.68	-	6	11		0	0	No
Nitrobenzene	370	-	480	17	40,000	0	0	No
N-Nitroso-di-n-propylamine	370	-	480	17		0	0	No

Table A1.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
N-nitrosodiphenylamine	370	-	480	17	20,000	0	0	No
n-Propylbenzene	1.50	-	6	11		0	0	No
PCB-1016	37	-	120	44	172	0	0	No
PCB-1221	37	-	120	44	172	0	0	No
PCB-1232	37	-	120	44	172	0	0	No
PCB-1242	37	-	120	44	172	0	0	No
PCB-1248	37	-	120	44	172	0	0	No
Pentachlorophenol	1,800	-	2,400	17	122	17	100	No
Phenol	370	-	480	17	23,090	0	0	No
sec-Butylbenzene	1.71	-	6	11		0	0	No
Styrene	1.42	-	13	14	16,408	0	0	No
tert-Butylbenzene	1.39	-	6	11		0	0	No
Toxaphene	160	-	230	39	3,756	0	0	No
trans-1,2-Dichloroethene	1.99	-	6	13	25,617	0	0	No
trans-1,3-Dichloropropene	1.67	-	13	14	2,800	0	0	No
Vinyl acetate	26	-	26	1	13,986	0	0	No
Vinyl Chloride	2.42	-	26	14	97.7	0	0	No
Xylene	2.83	-	13	14	1,140	0	0	No

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Inorganics (mg/kg)								
Aluminum	2,622	99.9	2,620	1,450	61,000	10.9	70	50
Ammonia	32	78.1	25	0.335	4.81	0.338	6.12	586
Antimony	2,482	20.0	497	0.270	348	0.0360	19.3	0.905
Arsenic	2,613	99.0	2,586	0.290	56.2	0.400	6.20	2.57
Barium	2,624	99.9	2,622	0.640	1,500	2.20	95	159
Beryllium	2,623	81.7	2,142	0.0710	26.8	0.0620	1.90	6.82
Boron	1,303	85.7	1,117	0.350	28	0.340	7	0.500
Cadmium	2,603	36.1	940	0.0600	270	0.0300	2.80	0.705
Chromium	2,624	99.2	2,604	1.20	210	2.20	19.8	0.400
Chromium VI	17	5.88	1.000	0.850	0.850	0.530	1.20	1.34
Cobalt	2,622	98.1	2,573	1.10	137	2.10	10.4	13
Copper	2,621	98.2	2,575	1.70	1,860	2.20	22.8	8.25
Cyanide	245	2.45	6.00	0.170	0.290	0.180	4.70	607
Fluoride	9	100	9	1.87	3.61	NA	NA	1.33
Lead	2,618	100	2,618	0.870	814	NA	NA	12.1
Lithium	2,433	94.5	2,300	0.990	50	1.60	20.6	2
Manganese	2,617	99.9	2,615	15	2,220	2.20	130	486
Mercury	2,541	48.8	1,239	0.00140	48	0.00120	0.190	1.00E-04
Molybdenum	2,421	47.0	1,138	0.140	19.1	0.0990	7.50	1.84
Nickel	2,620	97.5	2,554	1.90	280	1.60	19.1	0.431
Nitrate / Nitrite	450	83.3	375	0.216	765	0.200	5.60	4,478
Selenium	2,590	13.3	345	0.220	2.20	0.0540	4.50	0.754
Silver	2,589	28.4	735	0.0580	364	0.0490	7	2
Strontium	2,423	100.0	2,422	2.40	413	1.10	1.10	940
Thallium	2,597	14.1	366	0.100	5.80	0.0160	2.50	1
Tin	2,423	10.0	243	0.289	161	0.0780	58.5	2.90
Uranium	1,296	8.80	114	0.430	370	0.130	16.8	5
Vanadium	2,622	100.0	2,621	4.40	5,300	2.20	2.20	2
Zinc	2,622	99.8	2,617	4.20	11,900	2.20	99.8	0.646
Organics (ug/kg)								
1,1,1-Trichloroethane	633	1.58	10.00	1.10	47.7	0.587	680	551,453
1,1,2,2-Tetrachloroethane	632	0.158	1.000	1.39	1.39	0.527	680	60,701
1,1-Dichloroethane	633	0	0	NA	NA	0.512	680	3,121
1,1-Dichloroethene	633	0.158	1.000	7.90	7.90	0.610	680	16,909
1,2,3-Trichloropropane	517	0.193	1.000	1.47	1.47	0.525	129	13,883
1,2,4-Trichlorobenzene	1,549	0.323	5.00	0.870	150	0.621	7,000	777
1,2-Dichloroethane	629	0	0	NA	NA	0.522	680	2,764
1,2-Dichloroethene	101	0.990	1.000	16	16	5	680	25,617

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
1,2-Dichloropropane	633	0.316	2.00	18	140	0.413	680	49,910
1,3,5-Trimethylbenzene	515	6.60	34.0	0.610	490	0.535	65.2	7,598
1,4-Dichlorobenzene	1,329	0.677	9.00	0.450	110	0.649	6,900	20,000
2,4,5-T	9	11.1	1.000	1.80	1.80	21	100	162
2,4,5-Trichlorophenol	1,180	0.0847	1.000	1,100	1,100	330	34,000	4,000
2,4,6-Trichlorophenol	1,180	0.0847	1.000	950	950	330	7,000	161
2,4,6-Trinitrotoluene	8	12.5	1	56	56	0.220	250	283
2,4-DB	9	0	0	NA	NA	83	100	426
2,4-Dichlorophenol	1,180	0	0	NA	NA	330	7,000	2,744
2,4-Dinitrophenol	1,173	0	0	NA	NA	850	35,000	20,000
2,4-Dinitrotoluene	1,232	0	0	NA	NA	250	7,000	32.1
2,6-Dinitrotoluene	1,232	0	0	NA	NA	250	7,000	6,186
2378-TCDD	22	68.2	15.0	2.59E-05	0.00680	2.20E-04	0.00106	0.00425
2-Butanone	631	2.54	16.0	3	155	2.72	1,400	1.07E+06
2-Chlorophenol	1,180	0	0	NA	NA	330	7,000	281
2-Methylnaphthalene	1,223	6.95	85.0	34	12,000	330	7,000	2,769
2-Methylphenol	1,180	0	0	NA	NA	330	7,000	123,842
2-Nitroaniline	1,224	0	0	NA	NA	370	35,000	5,659
4,4'-DDD	468	0.427	2.00	3.50	10	1.80	190	13,726
4,4'-DDE	468	1.50	7.00	0.600	7.20	1.80	190	7.95
4,4'-DDT	468	0.855	4.00	9.10	26	1.80	190	1.20
4,6-Dinitro-2-methylphenol	1,176	0.0850	1.000	390	390	850	35,000	560
4-Chloroaniline	1,217	0	0	NA	NA	330	14,000	716
4-Methyl-2-pentanone	630	2.38	15.0	4	73	1.94	2,960	14,630
4-Nitroaniline	1,218	0.328	4.00	62	820	850	55,000	41,050
4-Nitrophenol	1,169	0.171	2.00	53	320	850	35,000	7,000
4-Nitrotoluene	5	0	0	NA	NA	250	250	61,422
Acenaphthene	1,239	22.3	276	21	44,000	330	6,900	20,000
Acetone	632	19.3	122	1.70	1,280	2.65	2,960	6,182
Aldrin	468	0.855	4.00	0.590	17	1.80	95	47.0
alpha-BHC	468	0.214	1.000	7.90	7.90	1.80	95	18,662
alpha-Chlordane	433	0	0	NA	NA	1.80	950	289
Benzene	633	0.948	6.00	1	11	0.502	680	500
Benzo(a)pyrene	1,235	41.2	509	36	43,000	19	7,000	631
Benzyl Alcohol	1,114	0.718	8.00	140	2,800	330	14,000	4,403
beta-BHC	467	0.428	2.00	11	11	1.80	95	207
beta-Chlordane	411	0.243	1.000	2.60	2.60	1.80	950	289
bis(2-ethylhexyl)phthalate	1,227	29.7	365	29	75,000	330	7,000	137
Bromodichloromethane	633	0	0	NA	NA	0.502	680	5,750

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Bromoform	633	0	0	NA	NA	0.525	680	2,855
Butylbenzylphthalate	1,226	9.79	120	35	7,100	330	7,000	24,155
Carbon Disulfide	633	0.158	1.000	4	4	0.535	680	5,676
Carbon Tetrachloride	633	3.32	21.0	0.340	103	0.575	680	8,906
Chlordane	34	0	0	NA	NA	18	220	289
Chlorobenzene	633	0.316	2.00	2	2.03	0.484	680	4,750
Chloroform	633	1.11	7.00	1.30	7	0.543	680	8,655
cis-1,2-Dichloroethene	517	1.74	9.00	1.10	15	0.502	590	1,814
cis-1,3-Dichloropropene	633	0	0	NA	NA	0.502	680	2,800
delta-BHC	468	0.214	1.000	23	23	1.80	95	25.9
Dibenzofuran	1,227	10.9	134	36	20,000	330	7,000	21,200
Dibromochloromethane	633	0	0	NA	NA	0.502	680	5,730
Dicamba	9	55.6	5.00	2.30	150	42	100	1,690
Dichlorodifluoromethane	499	0	0	NA	NA	1.73	398	855
Dieldrin	468	2.35	11.0	1.80	92	1.80	190	7.40
Diethylphthalate	1,224	0.654	8.00	33	420	330	7,000	100,000
Dimethoate	7	0	0	NA	NA	18	180	13.7
Dimethylphthalate	1,227	1.47	18.0	69	460	330	7,000	200,000
Di-n-butylphthalate	1,227	7.99	98.0	35	10,000	330	7,000	15.9
Di-n-octylphthalate	1,225	3.92	48.0	38	11,000	330	7,000	731,367
Endosulfan I	468	0.427	2.00	3.90	7.40	1.80	95	80.1
Endosulfan II	461	0.651	3.00	0.700	9.90	1.80	170	80.1
Endosulfan sulfate	468	0.641	3.00	5.50	24	1.80	190	80.1
Endrin	468	1.28	6.00	2.40	17	1.80	200	1.40
Endrin aldehyde	66	3.03	2.00	8.70	9.20	1.80	38	1.40
Endrin ketone	437	0.229	1.000	36	36	1.80	190	1.40
Fluorene	1,244	18.8	234	27	39,000	140	7,000	30,000
gamma-BHC (Lindane)	468	0.214	1.000	8.30	8.30	1.80	95	25.9
gamma-Chlordane	23	0	0	NA	NA	2	260	289
Heptachlor	468	0	0	NA	NA	1.80	95	63.3
Heptachlor epoxide	467	0.642	3.00	7.20	23	1.80	95	64.0
Hexachlorobenzene	1,224	0.327	4.00	110	380	330	7,000	7.73
Hexachlorobutadiene	1,550	0.0645	1.000	2.20	2.20	0.508	7,000	431
Hexachlorocyclopentadiene	1,208	0	0	NA	NA	330	7,000	5,518
Hexachloroethane	1,227	0	0	NA	NA	330	7,000	366
HMX	5	20	1	230	230	250	250	16,012
Methoxychlor	468	1.71	8.00	0.280	450	3.50	950	1,226
Methylene Chloride	631	12.0	76.0	0.790	45	0.502	2,200	3,399
Naphthalene	1,567	14.1	221	0.850	41,000	0.751	7,000	27,048

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Nitrobenzene	1,218	0	0	NA	NA	250	7,000	40,000
N-nitrosodiphenylamine	1,227	0	0	NA	NA	330	7,000	20,000
PCB-1016	795	0.755	6.00	13	95	33	4,500	172
PCB-1221	845	0	0	NA	NA	33	4,500	172
PCB-1232	845	0	0	NA	NA	33	4,500	172
PCB-1242	845	0.237	2.00	23	350	33	4,500	172
PCB-1248	845	0.710	6.00	17	840	33	4,500	172
PCB-1254	842	17.9	151	6.80	8,900	33	9,000	172
PCB-1260	838	17.2	144	6.20	7,800	33	4,300	172
Pentachlorophenol	1,180	1.02	12.0	39	39,000	850	35,000	122
Phenol	1,180	0.424	5.00	33	130	330	7,000	23,090
Styrene	633	0.158	1.000	7.80	7.80	0.550	680	16,408
Tetrachloroethene	633	8.53	54.0	0.380	29,000	0.641	680	763
Toluene	633	9.00	57.0	0.0990	990	0.528	60.8	14,416
Toxaphene	468	0	0	NA	NA	86	2,200	3,756
trans-1,2-Dichloroethene	532	0	0	NA	NA	0.738	93.3	25,617
trans-1,3-Dichloropropene	633	0	0	NA	NA	0.502	680	2,800
Trichloroethene	633	4.11	26.0	0.170	200	0.500	680	389
Vinyl acetate	78	0	0	NA	NA	10	1,400	13,986
Vinyl Chloride	633	0	0	NA	NA	0.748	1,400	97.7
Xylene	633	10.4	66.0	0.600	933	0.502	680	1,140

NA - Not Applicable

Table A1.5
Summary of Professional Judgment and Ecological Risk Potential

Analyte	Summary of Professional Judgment								Ecological Risk Potential						
	Listed as Waste Constituent for UWNEU Historical IHSSs ?[1]	**Historical RFETS Inventory [2] (1974/1988) (kg)**	**Maximum Conc. in Soil Sitewide (ug/kg)**	**Detection Frequency in Sitewide Soil (%)**	**Maximum Conc. in UWNEU Soil (ug/kg)**	**Detection Frequency in UWNEU Soil (%)**	**Potential to be an ECOPC?**	**Uncertainty Category[3]**	**Lowest ESL (ug/kg)**	**Most Sensitive Receptor[4]**	**LOAEL/ NOAEL [5]**	**LOAEL-Based Soil Conc. (ug/kg)**	**Maximum Reported Result for Non-detects in UWNEU (ug/kg)**	**Maximum Reported Result/ LOAEL-Based Soil Conc.[6]**	**Potential for Adverse Effects if Detected at Maximum Reported Result Level?**
2,4,6-Trichlorophenol	No	0/.01	950	0.1	NA	0	No	2	161	Deer Mouse Insectivore	100	16100	480	0.03	No
2,4-Dinitrotoluene	No	0/0	N/A	0	NA	0	No	1	32.1	Deer Mouse Insectivore	10	321	480	1	No
2-Chlorophenol	No	0.12/0.02	N/A	0	NA	0	No	1	281	Deer Mouse Insectivore	100	28100	480	0.02	No
4,4'-DDE	Yes(1)	0/0.001	7.2	1.5	NA	0	No	2	7.95	Mourning Dove Insectivore	10	79.5	23	0.3	No
4,4'-DDT	Yes(1)	0/0.001	26	0.9	NA	0	No	2	1.20	Mourning Dove Insectivore	167	200.4	23	0.1	No
4,6-Dinitro-2-methylphenol	No	0/0	390	0.1	NA	0	No	2	560	Deer Mouse Insectivore	20	11200	2,400	0.2	No
Dieldrin	Yes(1)	0/0.003	92	2.4	NA	0	No	3	7.40	Deer Mouse Insectivore	2	14.8	23	2	Yes
Endrin	Yes(1)	0/0.004	17	1.3	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	23	2	Yes
Endrin ketone	Yes(1)	0/0	36	0.2	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	23	2	Yes
Hexachlorobenzene	Yes(1)	1.000/1.005	380	0.3	NA	0	No	2	7.73	Mourning Dove Insectivore	40	309.2	480	2	Yes
Hexachloroethane	No	0.02/0.02	N/A	0	NA	0	No	2	366	Deer Mouse Insectivore	20	7320	480	0.07	No
Pentachlorophenol	No	0.02/0.02	39000	1.0	NA	0	No	3	122	Deer Mouse Insectivore	10	1220	2,400	2	Yes

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005a.
[2] CDH, 1991.
[3] See text for explanation.
[4] Basis for the lowest ESL.
[5] LOAELs and NOAELs from Appendix B, Table B-2, "TRVs for Terrestrial Vertebrate Receptors", Ref. DOE 2005b.
[6] Ratios are rounded to one significant figure.
(1) Historical IHSSs where either pesticides were stored, oil was released or burned, or transformers leaked are upgradient of the A- and B- series ponds. Therefore pesticides, PAHs, and PCBs are potential waste constituents for the UWNEU. The oils could have also contained phthalates.
CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ECOPC – Ecological Contaminant of Potential Concern
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOAEL – Lowest Bounded Lowest Observed Adverse Effect Level
NOAEL - Final No Observed Adverse Effect Level
RFETS – Rocky Flats Environmental Technology Site
UWNEU – Upper Walnut Drainage Exposure Unit
NA – Not applicable
NVA – No Value Available
I- Inconclusive

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Cyanide	0.504	-	0.602	10	2,200	0	0	No
Sulfide	12	-	14.1	10		0	0	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	5	-	6.80	20		0	0	No
1,1,1-Trichloroethane	5	-	740	133	4.85E+07	0	0	Yes
1,1,2,2-Tetrachloroethane	5	-	740	137	4.70E+06	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	5	-	6.80	20		0	0	No
1,1,2-Trichloroethane	5	-	740	137		0	0	No
1,1-Dichloroethane	5	-	740	137	215,360	0	0	No
1,1-Dichloroethene	5	-	740	136	1.28E+06	0	0	Yes
1,1-Dichloropropene	5	-	6.80	20		0	0	No
1,2,3-Trichloropropane	5	-	6.80	20	1.17E+06	0	0	No
1,2-Dibromo-3-chloropropane	5	-	6.80	20		0	0	No
1,2-Dibromoethane	5	-	6.80	20		0	0	No
1,2-Dichlorobenzene	5	-	6.80	20		0	0	No
1,2-Dichloroethane	5	-	740	135	2.00E+06	0	0	No
1,2-Dichloroethene	5	-	740	114	1.87E+06	0	0	Yes
1,2-Dichloropropane	5	-	740	137	3.92E+06	0	0	No
1,3,5-Trimethylbenzene	5	-	6.80	20	855,709	0	0	No
1,3-Dichlorobenzene	5	-	6.80	20		0	0	No
1,3-Dichloropropane	5	-	6.80	20		0	0	No
1,4-Dichlorobenzene	5	-	6.80	20	5.93E+06	0	0	No
123478-HxCDD	0.00135	-	0.00166	5		0	0	No
123678-HxCDD	0.00135	-	0.00166	5		0	0	No
123678-HxCDF	0.00135	-	0.00166	5		0	0	No
123789-HxCDD	0.00135	-	0.00166	5		0	0	No
123789-HxCDF	0.00135	-	0.00166	5		0	0	No
12378-PeCDF	0.00135	-	0.00166	5		0	0	No
2,2-Dichloropropane	5	-	6.80	20		0	0	No
2,4,5-Trichlorophenol	720	-	900	9		0	0	No
2,4,6-Trichlorophenol	720	-	900	9	17,263	0	0	No
2,4-Dichlorophenol	720	-	900	9	249,324	0	0	No
2,4-Dimethylphenol	720	-	900	9		0	0	No
2,4-Dinitrophenol	3,600	-	4,500	9	4.90E+06	0	0	No
2,4-Dinitrotoluene	720	-	900	10	2,473	0	0	No
2,6-Dinitrotoluene	720	-	900	10	477,309	0	0	No
234678-HxCDF	0.00135	-	0.00166	5		0	0	No
23478-PeCDF	0.00135	-	0.00166	5		0	0	No
2378-TCDF	5.40E-04	-	6.66E-04	5		0	0	No
2-Chloronaphthalene	720	-	900	10		0	0	No
2-Chlorophenol	720	-	900	9	21,598	0	0	No
2-Chlorotoluene	5	-	6.80	20		0	0	No
2-Hexanone	6	-	1,500	129		0	0	Yes
2-Methylnaphthalene	720	-	900	10	319,121	0	0	No
2-Methylphenol	720	-	900	9	9.26E+06	0	0	No
2-Nitroaniline	3,600	-	4,500	10	418,475	0	0	No
2-Nitrophenol	720	-	900	9		0	0	No
3,3'-Dichlorobenzidine	1,400	-	1,800	10		0	0	No
3-Nitroaniline	3,600	-	4,500	10		0	0	No
4,6-Dinitro-2-methylphenol	3,600	-	4,500	9	44,283	0	0	No
4-Bromophenyl-phenylether	720	-	900	10		0	0	No
4-Chloro-3-methylphenol	1,400	-	1,800	9		0	0	No
4-Chloroaniline	1,400	-	1,800	10	48,856	0	0	No

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
4-Chlorophenyl-phenyl ether	720	-	900	10		0	0	No
4-Chlorotoluene	5	-	6.80	20		0	0	No
4-Isopropyltoluene	5	-	6.80	20		0	0	No
4-Methyl-2-pentanone	6	-	1,500	126	859,131	0	0	Yes
4-Methylphenol	720	-	900	9		0	0	No
4-Nitroaniline	3,600	-	4,500	10	2.62E+06	0	0	No
4-Nitrophenol	3,600	-	4,500	9	1.02E+06	0	0	No
Acenaphthene	360	-	450	10		0	0	No
Acenaphthylene	360	-	450	10		0	0	No
Anthracene	360	-	450	10		0	0	No
Benzene	5	-	740	137	1.10E+06	0	0	No
Benzo(a)pyrene	720	-	900	10	502,521	0	0	No
Benzo(b)fluoranthene	720	-	900	10		0	0	No
Benzo(g,h,i)perylene	720	-	900	10		0	0	No
Benzo(k)fluoranthene	720	-	900	10		0	0	No
Benzoic Acid	3,600	-	4,500	9		0	0	No
Benzyl Alcohol	1,400	-	1,800	10	253,015	0	0	No
bis(2-Chloroethoxy) methane	720	-	900	10		0	0	No
bis(2-Chloroethyl) ether	720	-	900	10		0	0	No
bis(2-Chloroisopropyl) ether	720	-	900	10		0	0	No
Bromobenzene	5	-	6.80	20		0	0	No
Bromochloromethane	5	-	6.80	20		0	0	No
Bromodichloromethane	5	-	740	137	381,135	0	0	No
Bromoform	5	-	740	136	198,571	0	0	No
Bromomethane	5.10	-	1,500	132		0	0	No
Butylbenzylphthalate	720	-	900	10	3.37E+06	0	0	No
Carbon Disulfide	5	-	740	134	410,941	0	0	Yes
Carbon Tetrachloride	5	-	740	130	736,154	0	0	Yes
Chlorobenzene	5	-	740	136	413,812	0	0	Yes
Chloroethane	5.10	-	1,500	135		0	0	No
Chloromethane	5.10	-	1,500	136		0	0	No
cis-1,2-Dichloroethene	2.60	-	6	20	132,702	0	0	No
cis-1,3-Dichloropropene	5	-	740	137	222,413	0	0	No
Dibenz(a,h)anthracene	720	-	900	10		0	0	No
Dibenzofuran	720	-	900	10	2.44E+06	0	0	No
Dibromochloromethane	5	-	740	137	389,064	0	0	No
Dibromomethane	5	-	6.80	20		0	0	No
Dichlorodifluoromethane	5.10	-	13	20	59,980	0	0	No
Diethylphthalate	720	-	900	10	2.21E+08	0	0	No
Dimethylphthalate	720	-	900	10	1.35E+07	0	0	No
Di-n-butylphthalate	720	-	900	10	4.06E+07	0	0	No
Di-n-octylphthalate	720	-	900	10	2.58E+08	0	0	No
Ethylbenzene	5	-	740	137		0	0	No
Fluoranthene	720	-	900	10		0	0	No
Fluorene	720	-	900	10		0	0	No
Hexachlorobenzene	720	-	900	10	190,142	0	0	No
Hexachlorobutadiene	5	-	6.80	20	150,894	0	0	No
Hexachlorocyclopentadiene	720	-	900	10	799,679	0	0	No
Hexachloroethane	720	-	900	10	45,656	0	0	No
Indeno(1,2,3-cd)pyrene	720	-	900	10		0	0	No
Isophorone	720	-	900	10		0	0	No
Isopropylbenzene	5	-	6.80	20		0	0	No
Nitrobenzene	720	-	900	10		0	0	No
N-Nitroso-di-n-propylamine	720	-	900	10		0	0	No

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the UWNEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
N-nitrosodiphenylamine	720	-	900	10	2.15E+06	0	0	No
n-Propylbenzene	5	-	6.80	20		0	0	No
PCB-1016	36	-	87	10	37,963	0	0	No
PCB-1221	36	-	87	10	37,963	0	0	No
PCB-1232	36	-	87	10	37,963	0	0	No
PCB-1242	36	-	87	10	37,963	0	0	No
PCB-1248	36	-	87	10	37,963	0	0	No
PCB-1260	36	-	87	10	37,963	0	0	No
Pentachlorodibenzo-p-dioxin	0.00135	-	0.00166	5		0	0	No
Pentachlorophenol	3,600	-	4,500	9	18,373	0	0	No
Phenanthrene	720	-	900	10		0	0	No
Phenol	720	-	900	9	1.49E+06	0	0	No
Pyrene	720	-	900	10		0	0	No
Pyridine	720	-	900	10		0	0	No
sec-Butylbenzene	5	-	6.80	20		0	0	No
Styrene	5	-	740	137	1.53E+06	0	0	No
tert-Butylbenzene	5	-	6.80	20		0	0	No
trans-1,2-Dichloroethene	2.60	-	6	20	1.87E+06	0	0	No
trans-1,3-Dichloropropene	5	-	740	137	222,413	0	0	No
Vinyl acetate	10	-	1,500	112	730,903	0	0	No
Vinyl Chloride	5.10	-	1,500	137	6,494	0	0	No
Xylene	5	-	740	136	111,663	0	0	Yes

COMPREHENSIVE RISK ASSESSMENT
UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 2
Data Quality Assessment

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DAR	data adequacy report
DER	duplicate error ratio
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
ECOPC	ecological contaminant of potential concern
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
EU	exposure unit
FD	field duplicate
IAG	Interagency Agreement
ICP	inductively couple plasma
IDL	instrument detection limit
LCS	laboratory control sample
MDA	minimum detectable activity

MDL	method detection limit
MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
N/A	not applicable
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	Pipette
PRG	preliminary remediation goal
PCB	polychlorinated biphenyl
QC	quality control
RDL	required detection limit
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SDP	standard data package
SOW	Statement of Work
SVOC	semi-volatile organic compound
SWD	Soil Water Database
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
V&V	verification and validation
VOC	volatile organic compound
UWNEU	Upper Walnut Drainage Exposure Unit

1.0 INTRODUCTION

This document provides an assessment of the quality of the data used in the human health and ecological risk assessments for the Upper Walnut Drainage Exposure Unit (UWNEU). The data quality was evaluated against standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters by the data validator under the multiple work plans that guided the data collection over the past 15 years, as well as the requirements for the PARCC parameters provided in the Comprehensive Risk Assessment (CRA) Methodology (DOE 2005). The details of this data quality assessment (DQA) process are presented in the Sitewide DQA contained in Appendix A, Volume 2, Attachment 2 of the Remedial Investigation/Feasibility Study (RI/FS).

Of the 365,984 environmental sampling records in the RFETS database associated with the UWNEU, 187,634 were used in the UWNEU risk assessment based on the data processing rules described in Section 2.0 of the Sitewide DQA. Of the 187,634 analytical records existing in the UWNEU CRA data set, 76 percent (142,152 records) have undergone verification or validation (V&V) (Table A2.1). The V&V review involved applying observation notes and qualifiers flags or observation notes without qualifier flags to the data.

PARCC parameter analysis was used to determine if the data quality could affect the risk assessment decisions (i.e., have significant impact on risk calculations or selection of contaminants of concern [COCs] for human health or ecological contaminants of potential concern [ECOPCs]). In consultation with the data users and project team, the primary ways in which the PARCC parameters could impact the risk assessment decisions were identified and these include the following:

- Detect results are falsely identified as nondetects;
- Nondetect results are falsely identified as detects;
- Issues that cause detection limit uncertainty;
- Issues that cause significant overestimation of detect results; and
- Issues that cause significant underestimation of detect results.

2.0 SUMMARY OF FINDINGS

2.1 PARCC Findings

A summary of V&V observations and the associated, affected PARCC parameter is presented in Table A2.2 by analyte group and matrix (i.e., “soil” includes soil and sediment, and “water” includes surface water and groundwater). Table A2.3 presents the percentage of the UWNEU V&V data that were qualified as estimated and/or undetected by analyte group and matrix. Overall, approximately 14 percent of the UWNEU CRA data were qualified as estimated or undetected. Two percent of the data reported as detected by the laboratory were qualified as undetected by the validator due to blank contamination (Table A2.4). In general, data qualified as estimated or undetected are marked as such because of various laboratory noncompliance issues that are not serious enough to render the data unusable. The precision between field duplicate (FD)/target sample analyte pairs is summarized in Table A2.5.

Of the 76 percent of the UWNEU data set that underwent V&V, 83 percent were qualified as having no QC issues, and approximately 14 percent were qualified as estimated or undetected (Table A2.3). The remaining 3 percent of the V&V data are made up of records qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Less than 3 percent of the entire data set was rejected during the V&V process (Table A2.6). Rejected data were removed from the UWNEU CRA data set during the data processing as defined in Section 2.0 of the Sitewide DQA.

The general discussion below summarizes the data quality as presented by the data validator’s observations. The relationship between these observations and the PARCC parameters can be found in the Sitewide DQA. Several observations have no impact on data quality because they represent issues that were noted but corrected, or represent other, general observations such as missing documentation that was not required for data assessment. Approximately 20 percent of the UWNEU V&V data were marked with these V&V observations that have no affect on any of the PARCC parameters.

Of the V&V data, approximately 2 percent were noted for observations related to precision. Of that 2 percent, 99 percent contained issues related to sample matrices. Result confirmation and instrument setup observations make up the other 1 percent.

Of the V&V data, 36 percent were noted for accuracy-related observations. Of that 36 percent, 78 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 22 percent. It is important to note that not all accuracy-related observations resulted in data qualification. Only 14 percent of the UWNEU CRA data set was qualified as estimated and/or undetected (Table A2.3).

The data were determined to meet the representativeness parameter because sampling locations are spatially distributed such that contaminant randomness and bias considerations are addressed based on the site-specific history (see the Data Adequacy Report [DAR] in Appendix A, Volume 2, Attachment 3). Samples were also analyzed by the SW-846 or alpha-spectroscopy methods and results were documented as quality records according to approved procedures and guidelines (V&V).

Of the V&V data, approximately 38 percent were noted for observations related to representativeness. Of that 38 percent, 63 percent was marked for blank observations, 23 percent for failure to observe allowed holding times, 3 percent for documentation issues, 8 percent for sample preparation observations, and 2 percent for instrument sensitivity issues. Matrix, LCS, instrument set-up, and other observations make up the other 1 percent of the data noted for observations related to sample representativeness. Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs and samples were generally stored and preserved properly.

The CRA Methodology specifies completeness criteria based on data adequacy and these criteria and the findings are discussed in the DAR in Appendix A, Volume 2, Attachment 3 of the RI/FS. Additionally, it should be noted that less than 3 percent of all V&V data associated with the UWNEU were rejected.

Comparability of the UWNEU CRA data set is ensured as all analytical results have been converted into common units. Comparability is addressed more specifically in Appendix A, Volume 2, Attachment 2 of the RI/FS.

2.2 PARCC Findings Potential Impact on Data Usability

PARCC parameter influence on data usability is discussed below with an emphasis on the risk assessment decisions as described in the Introduction to this document.

Table A2.3 summarizes the overall percentage of qualified data, independent of validation observation. The table is used for overall guidance in selecting analyte group and matrix combinations of interest in the analysis of the risk assessment decisions, the impact on data usability is better analyzed using Tables A2.5 through A2.7, as these can be more directly related to the 5 key risk assessment decision factors described in the introduction.

A summary of FD/target sample precision information can be found in Table A2.5. Where there are analyte group and matrix combinations failures that have the potential to impact risk assessment decisions, the data quality is discussed in further detail in the bulleted list below.

Table A2.7 lists V&V observations where the number of observations by analyte group and matrix exceeds 5 percent of the associated records (see column “Percent Observed”) with the exception of those observations that were determined to have no impact on any of the PARCC parameters. Such observations are identified in Table A2.2 by an “Affected PARCC Parameter” of not applicable (N/A). Additionally the analyte group and matrix is broken down further in the columns “Percent Qualified U” and “Percent Qualified J”. Data qualifications that are considered to have potential impact on risk assessment decisions were reviewed and are discussed in detail in the bulleted list below. Other issues are not considered to have the potential for significant impacts on the results of the risk assessments because the uncertainty associated with these data quality issues is assumed to be less than the overall uncertainty in the risk assessment process (e.g., uncertainties such as exposure assumptions, toxicity values, and statistical methods for calculating exposure point concentrations).

Data qualifications associated with the water matrix are not discussed below. Surface water data are used in the ecological risk assessment for an EU only for those analytes identified as ECOPCs, and the surface water component of exposure contributes only minimally to the overall risk estimates. As described in the Sitewide DQA (Attachment 2 of Volume 2 of Appendix A of the RI/FS Report), groundwater data are not used in the ecological risk assessment and the groundwater evaluations for the human health portion of the risk assessment are performed on a sitewide basis. In addition, surface water is evaluated for the human health risk assessment on a sitewide basis. Therefore, data quality evaluations for groundwater and surface water are presented in the Sitewide DQA.

An issue that has the potential to impact the risk assessment decisions is described below.

- Several V&V observations related to the wet chemistry/soil analyte group and matrix combination resulted in data qualifications in notable percentages of the data set (Table A2.7). It is important to note, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity that are not directly related to site characterization. Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

3.0 CONCLUSIONS

This review concludes that the quality of the UWNEU data is acceptable and the CRA objectives for PARCC performance have generally been met. Where either CRA Methodology or V&V guidance have not been met, the data are either flagged by the V&V process, or for those instances where the frequency of issues may influence the risk assessment decisions, the data quality issues were reviewed for potential impact on risk assessment results.

Those elements of data quality that could affect risk assessment decisions in the UWNEU have been analyzed and it was concluded that the noted deviations from the PARCC parameter criteria have minimal impact on risk assessment results related to the UWNEU.

4.0 REFERENCES

DOE, 2002, Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report, Rocky Flats Environmental Technology Site, Golden, Colorado, March.

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1, September 2005.

TABLES

Table A2.1
CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Soil	153	153	100.00
Dioxins and Furans	Water	62	62	100.00
Herbicide	Soil	123	129	95.35
Herbicide	Water	230	837	27.48
Metal	Soil	8,654	8,749	98.91
Metal	Water	34,305	41,846	81.98
PCB	Soil	1,256	1,298	96.76
PCB	Water	462	1,015	45.52
Pesticide	Soil	2,337	2,464	94.85
Pesticide	Water	1,584	4,555	34.77
Radionuclide	Soil	2,300	2,422	94.96
Radionuclide	Water	11,578	18,598	62.25
SVOC	Soil	7,309	7,575	96.49
SVOC	Water	10,944	18,398	59.48
VOC	Soil	7,939	8,747	90.76
VOC	Water	48,375	63,592	76.07
Wet Chem	Soil	187	209	89.47
Wet Chem	Water	4,354	6,985	62.33
	Total	**142,152**	**187,634**	**75.76%**

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Dioxins and Furans	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	1	153	0.65	Accuracy
Dioxins and Furans	Water	Documentation Issues	Record added by the validator	No	6	62	9.68	N/A
Dioxins and Furans	Water	Documentation Issues	Transcription error	No	12	62	19.35	N/A
Dioxins and Furans	Water	Internal Standards	Internal standards did not meet criteria	No	4	62	6.45	Accuracy
Herbicide	Soil	Internal Standards	Internal standards did not meet criteria	No	1	123	0.81	Accuracy
Herbicide	Soil	Other	See hard copy for further explanation	No	2	123	1.63	N/A
Herbicide	Soil	Surrogates	Surrogate recovery criteria were not met	No	3	123	2.44	Accuracy
Herbicide	Water	Calculation Errors	Calculation error	No	3	230	1.30	N/A
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	No	12	230	5.22	Accuracy
Herbicide	Water	Documentation Issues	Record added by the validator	No	9	230	3.91	N/A
Herbicide	Water	Documentation Issues	Transcription error	No	51	230	22.17	N/A
Herbicide	Water	Holding Times	Holding times were exceeded	No	11	230	4.78	Representativeness
Herbicide	Water	Internal Standards	Internal standards did not meet criteria	No	3	230	1.30	Accuracy
Herbicide	Water	Other	Lab results not verified due to unsubmitted data	No	1	230	0.43	Representativeness
Herbicide	Water	Other	Sample results were not validated due to re-analysis	No	10	230	4.35	N/A
Herbicide	Water	Other	See hard copy for further explanation	No	14	230	6.09	N/A
Herbicide	Water	Sample Preparation	Samples were not properly preserved in the field	No	9	230	3.91	Representativeness
Herbicide	Water	Surrogates	Surrogate recovery criteria were not met	No	3	230	1.30	Accuracy
Metal	Soil	Blanks	Calibration verification blank contamination	No	98	8,654	1.13	Representativeness
Metal	Soil	Blanks	Calibration verification blank contamination	Yes	25	8,654	0.29	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	No	349	8,654	4.03	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	75	8,654	0.87	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	No	54	8,654	0.62	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	Yes	70	8,654	0.81	Representativeness
Metal	Soil	Calculation Errors	Control limits not assigned correctly	Yes	1	8,654	0.01	N/A
Metal	Soil	Calibration	Calibration correlation coefficient did not meet requirements	Yes	4	8,654	0.05	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	No	2	8,654	0.02	Accuracy
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	7	8,654	0.08	Accuracy
Metal	Soil	Documentation Issues	Missing deliverables (not required for validation)	No	6	8,654	0.07	N/A
Metal	Soil	Documentation Issues	Missing deliverables (not required for validation)	Yes	53	8,654	0.61	N/A
Metal	Soil	Documentation Issues	Missing deliverables (required for validation)	No	20	8,654	0.23	Representativeness
Metal	Soil	Documentation Issues	Missing deliverables (required for validation)	Yes	86	8,654	0.99	Representativeness
Metal	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	No	25	8,654	0.29	N/A
Metal	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	108	8,654	1.25	N/A
Metal	Soil	Documentation Issues	Record added by the validator	Yes	1	8,654	0.01	N/A
Metal	Soil	Documentation Issues	Transcription error	No	5	8,654	0.06	N/A
Metal	Soil	Documentation Issues	Transcription error	Yes	108	8,654	1.25	N/A
Metal	Soil	Holding Times	Holding times were exceeded	No	5	8,654	0.06	Representativeness
Metal	Soil	Holding Times	Holding times were exceeded	Yes	2	8,654	0.02	Representativeness
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	No	12	8,654	0.14	Accuracy
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	Yes	50	8,654	0.58	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	No	98	8,654	1.13	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	Yes	133	8,654	1.54	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	No	322	8,654	3.72	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	Yes	495	8,654	5.72	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	No	69	8,654	0.80	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	Yes	71	8,654	0.82	Accuracy
Metal	Soil	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	4	8,654	0.05	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	Yes	206	8,654	2.38	Precision
Metal	Soil	Matrices	LCS/LCSD precision criteria were not met	Yes	19	8,654	0.22	Precision
Metal	Soil	Matrices	MSA calibration correlation coefficient < 0.995	Yes	1	8,654	0.01	Accuracy
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	No	74	8,654	0.86	Accuracy
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	Yes	53	8,654	0.61	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	No	316	8,654	3.65	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	683	8,654	7.89	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery was < 30 percent	No	1	8,654	0.01	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	11	8,654	0.13	Accuracy
Metal	Soil	Matrices	Serial dilution criteria were not met	Yes	214	8,654	2.47	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	No	113	8,654	1.31	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	451	8,654	5.21	Accuracy
Metal	Soil	Other	Result obtained through dilution	No	1	8,654	0.01	N/A
Metal	Soil	Other	Result obtained through dilution	Yes	30	8,654	0.35	N/A
Metal	Soil	Sample Preparation	Sample pretreatment or preparation method was incorrect	No	5	8,654	0.06	Representativeness
Metal	Soil	Sample Preparation	Sample pretreatment or preparation method was incorrect	Yes	44	8,654	0.51	Representativeness
Metal	Soil	Sample Preparation	Samples were not properly preserved in the field	No	4	8,654	0.05	Representativeness
Metal	Soil	Sample Preparation	Samples were not properly preserved in the field	Yes	22	8,654	0.25	Representativeness
Metal	Soil	Sensitivity	IDL changed due to a significant figure discrepancy	No	1	8,654	0.01	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	No	1,169	34,305	3.41	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	Yes	188	34,305	0.55	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	1,463	34,305	4.26	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	836	34,305	2.44	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	No	411	34,305	1.20	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	Yes	286	34,305	0.83	Representativeness
Metal	Water	Calculation Errors	Control limits not assigned correctly	No	73	34,305	0.21	N/A
Metal	Water	Calculation Errors	Control limits not assigned correctly	Yes	84	34,305	0.24	N/A
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	No	175	34,305	0.51	Accuracy
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	25	34,305	0.07	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	No	15	34,305	0.04	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	Yes	41	34,305	0.12	Accuracy
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	No	22	34,305	0.06	Accuracy
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	Yes	20	34,305	0.06	Accuracy
Metal	Water	Documentation Issues	Electronic qualifiers were applied from validation report by hand	No	18	34,305	0.05	N/A
Metal	Water	Documentation Issues	Electronic qualifiers were applied from validation report by hand	Yes	11	34,305	0.03	N/A
Metal	Water	Documentation Issues	Information missing from case narrative	No	34	34,305	0.10	N/A
Metal	Water	Documentation Issues	Information missing from case narrative	Yes	35	34,305	0.10	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	No	131	34,305	0.38	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	Yes	630	34,305	1.84	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	No	236	34,305	0.69	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	145	34,305	0.42	N/A
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	No	98	34,305	0.29	Representativeness
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	103	34,305	0.30	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	735	34,305	2.14	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	965	34,305	2.81	N/A
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	44	34,305	0.13	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	25	34,305	0.07	Representativeness
Metal	Water	Documentation Issues	Original documentation not provided	No	6	34,305	0.02	N/A
Metal	Water	Documentation Issues	Original documentation not provided	Yes	6	34,305	0.02	N/A
Metal	Water	Documentation Issues	Record added by the validator	No	184	34,305	0.54	N/A
Metal	Water	Documentation Issues	Record added by the validator	Yes	222	34,305	0.65	N/A
Metal	Water	Documentation Issues	Transcription error	No	674	34,305	1.96	N/A
Metal	Water	Documentation Issues	Transcription error	Yes	558	34,305	1.63	N/A
Metal	Water	Holding Times	Holding times were exceeded	No	93	34,305	0.27	Representativeness
Metal	Water	Holding Times	Holding times were exceeded	Yes	17	34,305	0.05	Representativeness
Metal	Water	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	1	34,305	0.00	Precision
Metal	Water	Instrument Set-up	Element not analyzed in the interference check sample	Yes	2	34,305	0.01	Representativeness
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	No	245	34,305	0.71	Accuracy
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	274	34,305	0.80	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	No	171	34,305	0.50	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	Yes	210	34,305	0.61	Accuracy
Metal	Water	LCS	LCS data not submitted by the laboratory	No	2	34,305	0.01	Representativeness
Metal	Water	LCS	LCS recovery criteria were not met	No	218	34,305	0.64	Accuracy
Metal	Water	LCS	LCS recovery criteria were not met	Yes	477	34,305	1.39	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	No	264	34,305	0.77	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	Yes	195	34,305	0.57	Accuracy
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	114	34,305	0.33	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	72	34,305	0.21	Representativeness
Metal	Water	Matrices	Duplicate sample precision criteria were not met	No	54	34,305	0.16	Precision
Metal	Water	Matrices	Duplicate sample precision criteria were not met	Yes	223	34,305	0.65	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	No	43	34,305	0.13	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	47	34,305	0.14	Precision
Metal	Water	Matrices	MS/MSD precision criteria were not met	No	13	34,305	0.04	Precision
Metal	Water	Matrices	MS/MSD precision criteria were not met	Yes	3	34,305	0.01	Precision
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	No	2	34,305	0.01	Accuracy
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	Yes	10	34,305	0.03	Accuracy
Metal	Water	Matrices	MSA was required, but not performed	Yes	2	34,305	0.01	Representativeness
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	No	448	34,305	1.31	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	Yes	78	34,305	0.23	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	No	536	34,305	1.56	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	517	34,305	1.51	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	18	34,305	0.05	Accuracy
Metal	Water	Matrices	Recovery criteria were not met	Yes	1	34,305	0.00	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	No	32	34,305	0.09	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	Yes	539	34,305	1.57	Accuracy
Metal	Water	Other	Analysis was not requested according to the statement of work	No	2	34,305	0.01	N/A
Metal	Water	Other	Analysis was not requested according to the statement of work	Yes	2	34,305	0.01	N/A
Metal	Water	Other	IDL is older than 3 months from date of analysis	No	378	34,305	1.10	Accuracy
Metal	Water	Other	IDL is older than 3 months from date of analysis	Yes	493	34,305	1.44	Accuracy
Metal	Water	Other	Incorrect analysis sequence	No	2	34,305	0.01	Representativeness
Metal	Water	Other	Incorrect analysis sequence	Yes	5	34,305	0.01	Representativeness
Metal	Water	Other	QC sample frequency does not meet method requirements	No	15	34,305	0.04	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Other	QC sample frequency does not meet method requirements	Yes	25	34,305	0.07	Representativeness
Metal	Water	Other	Result obtained through dilution	No	3	34,305	0.01	N/A
Metal	Water	Other	Result obtained through dilution	Yes	25	34,305	0.07	N/A
Metal	Water	Other	See hard copy for further explanation	No	478	34,305	1.39	N/A
Metal	Water	Other	See hard copy for further explanation	Yes	656	34,305	1.91	N/A
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	No	412	34,305	1.20	Representativeness
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	698	34,305	2.03	Representativeness
Metal	Water	Sensitivity	IDL changed due to a significant figure discrepancy	No	91	34,305	0.27	Representativeness
PCB	Soil	Confirmation	Confirmation percent difference criteria not met	Yes	6	1,256	0.48	Precision
PCB	Soil	Matrices	Percent solids < 30 percent	Yes	3	1,256	0.24	Representativeness
PCB	Soil	Surrogates	Surrogate recovery criteria were not met	No	20	1,256	1.59	Accuracy
PCB	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	1	1,256	0.08	Accuracy
PCB	Water	Documentation Issues	Key data fields incorrect	No	7	462	1.52	N/A
PCB	Water	Documentation Issues	Record added by the validator	No	35	462	7.58	N/A
PCB	Water	Documentation Issues	Transcription error	No	48	462	10.39	N/A
PCB	Water	Documentation Issues	Transcription error	Yes	1	462	0.22	N/A
PCB	Water	Holding Times	Holding times were exceeded	No	14	462	3.03	Representativeness
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	20	462	4.33	Accuracy
PCB	Water	Surrogates	Surrogate recovery criteria were not met	Yes	1	462	0.22	Accuracy
Pesticide	Soil	Calibration	Continuing calibration verification criteria were not met	No	1	2,337	0.04	Accuracy
Pesticide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	2	2,337	0.09	Accuracy
Pesticide	Soil	Documentation Issues	Transcription error	No	8	2,337	0.34	N/A
Pesticide	Soil	Internal Standards	Internal standards did not meet criteria	No	1	2,337	0.04	Accuracy
Pesticide	Soil	Other	See hard copy for further explanation	No	1	2,337	0.04	N/A
Pesticide	Soil	Surrogates	Surrogate recovery criteria were not met	No	79	2,337	3.38	Accuracy
Pesticide	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	3	2,337	0.13	Accuracy
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	No	18	1,584	1.14	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	1,584	0.06	Accuracy
Pesticide	Water	Documentation Issues	Key data fields incorrect	No	20	1,584	1.26	N/A
Pesticide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	1	1,584	0.06	Representativeness
Pesticide	Water	Documentation Issues	Record added by the validator	No	109	1,584	6.88	N/A
Pesticide	Water	Documentation Issues	Transcription error	No	27	1,584	1.70	N/A
Pesticide	Water	Documentation Issues	Transcription error	Yes	3	1,584	0.19	N/A
Pesticide	Water	Holding Times	Holding times were exceeded	No	41	1,584	2.59	Representativeness
Pesticide	Water	Internal Standards	Internal standards did not meet criteria	No	3	1,584	0.19	Accuracy
Pesticide	Water	Other	Lab results not verified due to unsubmitted data	No	1	1,584	0.06	Representativeness
Pesticide	Water	Other	See hard copy for further explanation	No	3	1,584	0.19	N/A
Pesticide	Water	Other	See hard copy for further explanation	Yes	7	1,584	0.44	N/A
Pesticide	Water	Sample Preparation	Samples were not properly preserved in the field	No	11	1,584	0.69	Representativeness
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	63	1,584	3.98	Accuracy
Radionuclide	Soil	Blanks	Blank recovery criteria were not met	Yes	63	2,300	2.74	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	No	3	2,300	0.13	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	191	2,300	8.30	Representativeness
Radionuclide	Soil	Calculation Errors	Calculation error	Yes	16	2,300	0.70	N/A
Radionuclide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	310	2,300	13.48	Accuracy
Radionuclide	Soil	Documentation Issues	Key data fields incorrect	Yes	5	2,300	0.22	N/A
Radionuclide	Soil	Documentation Issues	Missing deliverables (required for validation)	No	1	2,300	0.04	Representativeness
Radionuclide	Soil	Documentation Issues	Missing deliverables (required for validation)	Yes	11	2,300	0.48	Representativeness
Radionuclide	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	No	1	2,300	0.04	N/A
Radionuclide	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	11	2,300	0.48	N/A
Radionuclide	Soil	Documentation Issues	Record added by the validator	Yes	22	2,300	0.96	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Soil	Documentation Issues	Results were not included on Data Summary Table	No	9	2,300	0.39	N/A
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	No	3	2,300	0.13	Representativeness
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	510	2,300	22.17	Representativeness
Radionuclide	Soil	Documentation Issues	Transcription error	No	12	2,300	0.52	N/A
Radionuclide	Soil	Documentation Issues	Transcription error	Yes	668	2,300	29.04	N/A
Radionuclide	Soil	Holding Times	Holding times were grossly exceeded	Yes	12	2,300	0.52	Representativeness
Radionuclide	Soil	Instrument Set-up	Detector efficiency did not meet requirements	Yes	20	2,300	0.87	Accuracy
Radionuclide	Soil	Instrument Set-up	Resolution criteria were not met	No	1	2,300	0.04	Representativeness
Radionuclide	Soil	Instrument Set-up	Resolution criteria were not met	Yes	119	2,300	5.17	Representativeness
Radionuclide	Soil	LCS	LCS data not submitted by the laboratory	Yes	9	2,300	0.39	Representativeness
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	No	2	2,300	0.09	Accuracy
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	209	2,300	9.09	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	No	1	2,300	0.04	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	Yes	25	2,300	1.09	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	No	3	2,300	0.13	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	174	2,300	7.57	Accuracy
Radionuclide	Soil	Matrices	Recovery criteria were not met	No	1	2,300	0.04	Accuracy
Radionuclide	Soil	Matrices	Recovery criteria were not met	Yes	14	2,300	0.61	Accuracy
Radionuclide	Soil	Matrices	Replicate analysis was not performed	Yes	4	2,300	0.17	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	No	10	2,300	0.43	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	182	2,300	7.91	Precision
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	No	3	2,300	0.13	Accuracy
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	Yes	27	2,300	1.17	Accuracy
Radionuclide	Soil	Other	Lab results not verified due to unsubmitted data	No	9	2,300	0.39	Representativeness
Radionuclide	Soil	Other	Lab results not verified due to unsubmitted data	Yes	9	2,300	0.39	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	No	11	2,300	0.48	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	Yes	22	2,300	0.96	Representativeness
Radionuclide	Soil	Other	Sample exceeded efficiency curve weight limit	Yes	4	2,300	0.17	Accuracy
Radionuclide	Soil	Other	See hard copy for further explanation	No	1	2,300	0.04	N/A
Radionuclide	Soil	Other	See hard copy for further explanation	Yes	88	2,300	3.83	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Soil	Other	Tracer requirements were not met	No	1	2,300	0.04	Accuracy
Radionuclide	Soil	Other	Tracer requirements were not met	Yes	2	2,300	0.09	Accuracy
Radionuclide	Soil	Other	Unit conversion of results	Yes	2	2,300	0.09	N/A
Radionuclide	Soil	Sensitivity	Incorrect reported activity or MDA	Yes	2	2,300	0.09	N/A
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	No	9	2,300	0.39	Representativeness
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	Yes	15	2,300	0.65	Representativeness
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	No	1	2,300	0.04	N/A
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	Yes	970	2,300	42.17	N/A
Radionuclide	Soil	Sensitivity	Results considered qualitative not quantitative	No	4	2,300	0.17	Accuracy
Radionuclide	Soil	Sensitivity	Results considered qualitative not quantitative	Yes	4	2,300	0.17	Accuracy
Radionuclide	Water	Blanks	Blank correction was not performed	No	4	11,578	0.03	Representativeness
Radionuclide	Water	Blanks	Blank correction was not performed	Yes	6	11,578	0.05	Representativeness
Radionuclide	Water	Blanks	Blank data not submitted	Yes	1	11,578	0.01	Representativeness
Radionuclide	Water	Blanks	Blank recovery criteria were not met	No	11	11,578	0.10	Representativeness
Radionuclide	Water	Blanks	Blank recovery criteria were not met	Yes	19	11,578	0.16	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	No	123	11,578	1.06	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	476	11,578	4.11	Representativeness
Radionuclide	Water	Calculation Errors	Calculation error	No	57	11,578	0.49	N/A
Radionuclide	Water	Calculation Errors	Calculation error	Yes	75	11,578	0.65	N/A
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	No	16	11,578	0.14	Accuracy
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	Yes	9	11,578	0.08	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	No	80	11,578	0.69	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	658	11,578	5.68	Accuracy
Radionuclide	Water	Documentation Issues	Information missing from case narrative	No	28	11,578	0.24	N/A
Radionuclide	Water	Documentation Issues	Information missing from case narrative	Yes	46	11,578	0.40	N/A
Radionuclide	Water	Documentation Issues	Key data fields incorrect	Yes	1	11,578	0.01	N/A
Radionuclide	Water	Documentation Issues	Missing deliverables (not required for validation)	No	14	11,578	0.12	N/A
Radionuclide	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	33	11,578	0.29	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	No	19	11,578	0.16	Representativeness
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	30	11,578	0.26	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	124	11,578	1.07	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	375	11,578	3.24	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	2	11,578	0.02	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	6	11,578	0.05	Representativeness
Radionuclide	Water	Documentation Issues	Record added by the validator	Yes	62	11,578	0.54	N/A
Radionuclide	Water	Documentation Issues	Sample analysis was not requested	No	1	11,578	0.01	N/A
Radionuclide	Water	Documentation Issues	Sample analysis was not requested	Yes	9	11,578	0.08	N/A
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	No	12	11,578	0.10	Representativeness
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	457	11,578	3.95	Representativeness
Radionuclide	Water	Documentation Issues	Transcription error	No	406	11,578	3.51	N/A
Radionuclide	Water	Documentation Issues	Transcription error	Yes	348	11,578	3.01	N/A
Radionuclide	Water	Holding Times	Holding times were exceeded	No	35	11,578	0.30	Representativeness
Radionuclide	Water	Holding Times	Holding times were exceeded	Yes	35	11,578	0.30	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	No	10	11,578	0.09	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	Yes	17	11,578	0.15	Representativeness
Radionuclide	Water	Instrument Set-up	Resolution criteria were not met	No	3	11,578	0.03	Representativeness
Radionuclide	Water	Instrument Set-up	Resolution criteria were not met	Yes	50	11,578	0.43	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	No	6	11,578	0.05	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	Yes	1	11,578	0.01	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	No	17	11,578	0.15	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	Yes	35	11,578	0.30	Representativeness
Radionuclide	Water	LCS	LCS data not submitted by the laboratory	Yes	2	11,578	0.02	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	No	187	11,578	1.62	Accuracy
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	Yes	174	11,578	1.50	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	No	6	11,578	0.05	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	Yes	50	11,578	0.43	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	No	94	11,578	0.81	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	Yes	286	11,578	2.47	Accuracy
Radionuclide	Water	Matrices	Duplicate analysis was not performed	No	4	11,578	0.03	Precision
Radionuclide	Water	Matrices	Duplicate analysis was not performed	Yes	11	11,578	0.10	Precision
Radionuclide	Water	Matrices	Duplicate sample precision criteria were not met	No	7	11,578	0.06	Precision
Radionuclide	Water	Matrices	Duplicate sample precision criteria were not met	Yes	17	11,578	0.15	Precision
Radionuclide	Water	Matrices	Recovery criteria were not met	No	16	11,578	0.14	Accuracy
Radionuclide	Water	Matrices	Recovery criteria were not met	Yes	57	11,578	0.49	Accuracy
Radionuclide	Water	Matrices	Replicate analysis was not performed	Yes	106	11,578	0.92	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	No	99	11,578	0.86	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	Yes	273	11,578	2.36	Precision
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	No	3	11,578	0.03	Accuracy
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	Yes	17	11,578	0.15	Accuracy
Radionuclide	Water	Other	Lab results not verified due to unsubmitted data	No	4	11,578	0.03	Representativeness
Radionuclide	Water	Other	Lab results not verified due to unsubmitted data	Yes	26	11,578	0.22	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	No	43	11,578	0.37	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	Yes	98	11,578	0.85	Representativeness
Radionuclide	Water	Other	Sample exceeded efficiency curve weight limit	Yes	7	11,578	0.06	Accuracy
Radionuclide	Water	Other	Sample or control analyses not chemically separated	Yes	6	11,578	0.05	Representativeness
Radionuclide	Water	Other	Sample results were not validated due to re-analysis	No	1	11,578	0.01	N/A
Radionuclide	Water	Other	See hard copy for further explanation	No	158	11,578	1.36	N/A
Radionuclide	Water	Other	See hard copy for further explanation	Yes	281	11,578	2.43	N/A
Radionuclide	Water	Other	Tracer requirements were not met	No	46	11,578	0.40	Accuracy
Radionuclide	Water	Other	Tracer requirements were not met	Yes	130	11,578	1.12	Accuracy
Radionuclide	Water	Other	Unit conversion of results	Yes	3	11,578	0.03	N/A
Radionuclide	Water	Sample Preparation	Improper aliquot size	No	2	11,578	0.02	Accuracy
Radionuclide	Water	Sample Preparation	Improper aliquot size	Yes	2	11,578	0.02	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	Sample Preparation	Preservation requirements were not met by the laboratory	No	1	11,578	0.01	Representativeness
Radionuclide	Water	Sample Preparation	Samples were not properly preserved in the field	No	23	11,578	0.20	Representativeness
Radionuclide	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	48	11,578	0.41	Representativeness
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	No	20	11,578	0.17	N/A
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	Yes	12	11,578	0.10	N/A
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	No	94	11,578	0.81	Representativeness
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	Yes	257	11,578	2.22	Representativeness
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	No	23	11,578	0.20	N/A
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	Yes	1,238	11,578	10.69	N/A
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	34	7,309	0.47	Representativeness
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	6	7,309	0.08	Representativeness
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	No	10	7,309	0.14	Accuracy
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	16	7,309	0.22	Accuracy
SVOC	Soil	Calibration	Independent calibration verification criteria not met	No	12	7,309	0.16	Accuracy
SVOC	Soil	Documentation Issues	Transcription error	No	3	7,309	0.04	N/A
SVOC	Soil	Documentation Issues	Transcription error	Yes	1	7,309	0.01	N/A
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	No	85	7,309	1.16	Accuracy
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	Yes	10	7,309	0.14	Accuracy
SVOC	Soil	Other	See hard copy for further explanation	No	97	7,309	1.33	N/A
SVOC	Soil	Other	See hard copy for further explanation	Yes	35	7,309	0.48	N/A
SVOC	Soil	Sample Preparation	Samples were not properly preserved in the field	No	3	7,309	0.04	Representativeness
SVOC	Soil	Surrogates	Surrogate recovery criteria were not met	No	178	7,309	2.44	Accuracy
SVOC	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	16	7,309	0.22	Accuracy
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	16	10,944	0.15	Representativeness
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	6	10,944	0.05	Representativeness
SVOC	Water	Calculation Errors	Calculation error	No	25	10,944	0.23	N/A
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	No	101	10,944	0.92	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	Yes	4	10,944	0.04	Accuracy
SVOC	Water	Calibration	Independent calibration verification criteria not met	No	35	10,944	0.32	Accuracy
SVOC	Water	Documentation Issues	Information missing from case narrative	No	6	10,944	0.05	N/A
SVOC	Water	Documentation Issues	Missing deliverables (not required for validation)	No	63	10,944	0.58	N/A
SVOC	Water	Documentation Issues	Missing deliverables (required for validation)	No	6	10,944	0.05	Representativeness
SVOC	Water	Documentation Issues	No mass spectra were provided	No	1	10,944	0.01	Representativeness
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	254	10,944	2.32	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	4	10,944	0.04	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	8	10,944	0.07	Representativeness
SVOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	1	10,944	0.01	Representativeness
SVOC	Water	Documentation Issues	Original documentation not provided	No	18	10,944	0.16	N/A
SVOC	Water	Documentation Issues	Record added by the validator	No	368	10,944	3.36	N/A
SVOC	Water	Documentation Issues	Record added by the validator	Yes	2	10,944	0.02	N/A

Table A2.3
Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect	Percent Qualified (%)
Dioxins and Furans	Soil	1	153	Yes	0.65
Dioxins and Furans	Water	4	62	No	6.45
Herbicide	Soil	3	123	No	2.44
Herbicide	Water	44	230	No	19.13
Metal	Soil	1,269	8,654	No	14.66
Metal	Soil	1,901	8,654	Yes	21.97
Metal	Water	5,208	34,305	No	15.18
Metal	Water	4,233	34,305	Yes	12.34
PCB	Soil	14	1,256	No	1.11
PCB	Soil	3	1,256	Yes	0.24
PCB	Water	34	462	No	7.36
Pesticide	Soil	42	2,337	No	1.80
Pesticide	Soil	2	2,337	Yes	0.09
Pesticide	Water	117	1,584	No	7.39
Radionuclide	Soil	17	2,300	No	0.74
Radionuclide	Soil	7	2,300	Yes	0.30
Radionuclide	Water	72	11,578	No	0.62
Radionuclide	Water	137	11,578	Yes	1.18
SVOC	Soil	228	7,309	No	3.12
SVOC	Soil	19	7,309	Yes	0.26
SVOC	Water	1,073	10,944	No	9.80
SVOC	Water	8	10,944	Yes	0.07
VOC	Soil	870	7,939	No	10.96
VOC	Soil	53	7,939	Yes	0.67
VOC	Water	4,190	48,375	No	8.66
VOC	Water	227	48,375	Yes	0.47
Wet Chem	Soil	10	187	No	5.35
Wet Chem	Soil	105	187	Yes	56.15
Wet Chem	Water	119	4,354	No	2.73
Wet Chem	Water	274	4,354	Yes	6.29
	Total	**20,284**	**142,152**		**14.27%**

Table A2.4
Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected Due to Blank Contaimination	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Soil	73	6,309	1.16
Metal	Water	746	17,266	4.32
Radionuclide	Water	3	8,444	0.04
VOC	Soil	1	332	0.30
VOC	Water	14	1,821	0.77
Wet Chem	Water	2	3,613	0.06
	Total	**839**	**37,785**	**2.22%**

[a] As determined by the laboratory prior to V&V.

Table A2.5
Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Dioxins and Furans	Water	0	1	0.00	1.61
Herbicide	Soil	0	10	0.00	7.75
Herbicide	Water	0	10	0.00	1.19
Metal	Soil	77	853	9.03	9.75
Metal	Water	63	1,684	3.74	4.02
PCB	Soil	0	112	0.00	8.63
PCB	Water	0	21	0.00	2.07
Pesticide	Soil	0	230	0.00	9.33
Pesticide	Water	0	84	0.00	1.84
Radionuclide	Soil	9	266	3.38	10.98
Radionuclide	Water	9	810	1.11	4.36
SVOC	Soil	0	589	0.00	7.78
SVOC	Water	0	520	0.00	2.83
VOC	Soil	1	524	0.19	5.99
VOC	Water	27	3,463	0.78	5.45
Wet Chem	Soil	1	17	5.88	8.13
Wet Chem	Water	5	241	2.07	3.45

Table A2.6
Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Dioxins and Furans	Soil	0	153	0.00
Dioxins and Furans	Water	0	97	0.00
Herbicide	Soil	3	185	1.62
Herbicide	Water	11	315	3.49
Metal	Soil	151	12,116	1.25
Metal	Water	878	47,529	1.85
PCB	Soil	54	1,800	3.00
PCB	Water	14	826	1.69
Pesticide	Soil	41	3,372	1.22
Pesticide	Water	55	2,760	1.99
Radionuclide	Soil	401	14,111	2.84
Radionuclide	Water	1,284	16,942	7.58
SVOC	Soil	139	10,501	1.32
SVOC	Water	597	15,045	3.97
VOC	Soil	421	15,785	2.67
VOC	Water	2,051	66,058	3.10
Wet Chem	Soil	45	326	13.80
Wet Chem	Water	100	6,141	1.63
	Total	**6,245**	**214,062**	**2.92%**

Table A2.7
Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Dioxins and Furans	WATER	Internal Standards	Internal standards did not meet criteria	No	6.45	0.00	6.45	Accuracy	No
Metal	SOIL	LCS	LCS recovery criteria were not met	Yes	5.72	0.00	5.72	Accuracy	No
Metal	SOIL	Matrices	Predigestion MS recovery criteria were not met	Yes	7.89	0.00	7.89	Accuracy	No
Radionuclide	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	8.30	0.00	0.00	Representativeness	No
Radionuclide	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	13.48	0.00	0.00	Accuracy	No
Radionuclide	SOIL	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	22.17	0.00	0.00	Representativeness	No
Radionuclide	SOIL	LCS	LCS recovery > +/- 3 sigma	Yes	9.09	0.00	0.00	Accuracy	No
Radionuclide	SOIL	LCS	LCS relative percent error criteria not met	Yes	7.57	0.00	0.00	Accuracy	No
Radionuclide	SOIL	Matrices	Replicate precision criteria were not met	Yes	7.91	0.00	0.00	Precision	No
Radionuclide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	5.68	0.00	0.22	Accuracy	No
SVOC	WATER	Sample Preparation	Samples were not properly preserved in the field	No	5.94	0.42	0.02	Representativeness	No
VOC	SOIL	Surrogates	Surrogate recovery criteria were not met	No	6.06	5.54	0.40	Accuracy	No
Wet Chem	SOIL	Matrices	Predigestion MS recovery criteria were not met	Yes	22.99	0.00	22.99	Accuracy	No
Wet Chem	SOIL	Matrices	Predigestion MS recovery was < 30 percent	Yes	25.67	0.00	25.67	Accuracy	No
Wet Chem	SOIL	Other	IDL is older than 3 months from date of analysis	Yes	6.95	0.00	6.42	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

COMPREHENSIVE RISK ASSESSMENT

UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

µg/kg	microgram per kilogram
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EcoSSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
GIS	Geographical Information System
HEPA	High-Efficiency Particulate Air
HHRA	Human Health Risk Assessment
IA	Industrial Area
IAEU	Industrial Area Exposure Unit
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NCP	National Contingency Plan

NOAEL	no observed adverse effect level
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PCOC	potential contaminant of concern
PDSR	Pre-Demolition Survey Report
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
tESL	threshold ESL
UCL	upper confidence limit
UTL	upper tolerance limit
UWNEU	Upper Walnut Drainage Exposure Unit
WRW	wildlife refuge worker

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select human health contaminants of concern (COCs) as part of the Human Health Risk Assessment (HHRA) and ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for the Upper Walnut Drainage Exposure Unit (UWNEU) at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2 of the RI/FS Report following the CRA Methodology (DOE 2005).

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE UPPER WALNUT DRAINAGE EXPOSURE UNIT

The results of the statistical background comparisons for inorganic and radionuclide potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil samples collected from the UWNEU are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 through A3.2.27.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil (Preble's meadow jumping mouse [PMJM] receptor) and PCOCs with concentrations in the UWNEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the professional judgment step of the COC/ECOPC selection processes. ECOIs (for non-PMJM receptors) with concentrations in the UWNEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the upper-bound exposure point concentration (EPC) – threshold ecological screening level (tESL) comparison step of the ECOPC selection processes.

[1] Statistical background comparisons are not performed for analytes if: 1) the background concentrations are non-detections; 2) background data are unavailable; 3) the analyte has low detection frequency in the UWNEU or background data set (less than 20 percent); or 4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

PCOCs and ECOIs with concentrations that are not statistically greater than background are not identified as COCs/ECOPCs and are not evaluated further.

2.1 Surface Soil/Surface Sediment Data Used in the HHRA

For the UWNEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) for aluminum, chromium, iron, manganese, cesium-134, plutonium-239/240, and radium-226 exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs), but the upper confidence limit on the mean concentrations (UCLs) for the site data set do not exceed the PRGs; these analytes are not evaluated further. The MDCs and UCLs for arsenic, benzo(a)pyrene, cesium-137, and radium-228 exceed the PRGs for the UWNEU data set; these analytes were carried forward into the statistical background comparison step. The results of the statistical comparison of the UWNEU surface soil/surface sediment data to background data for these PCOCs are presented in Table A3.2.1, and the summary statistics for background and UWNEU surface soil/surface sediment data are shown in Table A3.2.2.

The results of the statistical comparisons of the UWNEU surface soil/surface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Arsenic

Not Statistically Greater than Background at the 0.1 Significance Level

- Cesium-137
- Radium-228

Background Comparison Not Performed[1]

- Benzo(a)pyrene

2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

The MDC and UCL for radium-228 exceed the PRG for the UWNEU subsurface soil/subsurface sediment data set and, therefore, radium-228 was carried forward into the statistical background comparison step. The results of the statistical comparison of the UWNEU subsurface soil/subsurface sediment data to the background data are presented in Table A3.2.3, and the summary statistics for the UWNEU subsurface soil/subsurface sediment data to background data are presented in Table A3.2.4.

The results of the statistical comparisons of the UWNEU subsurface soil/subsurface data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Radium-228

Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison not Performed[1]

- None

2.3 Surface Soil Data Used in the ERA (Non-PMJM)

For the surface soil data set, the MDCs for aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, vanadium, and zinc exceed a non- PMJM ESL; therefore, these analytes were carried forward into the statistical background comparison step. The MDCs for bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total polychlorinated biphenyls (PCBs) also exceed a non-PMJM ESL. The results of the statistical comparison of the UWNEU surface soil data to background data are presented in Table A3.2.5, and the summary statistics for background and UWNEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the UWNEU surface soil (non-PMJM) to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Barium
- Cobalt
- Copper
- Nickel
- Vanadium
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Cadmium
- Chromium

- Lead
- Lithium
- Manganese
- Mercury

***Background Comparison not Performed*[1]**

- Antimony
- Boron
- Molybdenum
- Selenium
- Silver
- Thallium
- Tin
- Bis(2 ethylhexyl)phthalate
- di-n-butylphthalate
- Total PCBs

2.4 Surface Soil Data Used in the ERA (PMJM)

The MDCs for antimony, arsenic, cadmium, chromium, manganese, mercury, nickel, selenium, tin, vanadium, and zinc exceed the ESLs for the PMJM receptor for the UWNEU surface soil data set (i.e., samples within the PMJM habitat areas) and were carried forward into the background comparison step. The results of the statistical comparison of the UWNEU surface soil data to background data are presented in Table A3.2.7, and the summary statistics for background and UWNEU surface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the UWNEU surface soil (PMJM) to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Nickel
- Vanadium
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Cadmium
- Chromium
- Manganese
- Mercury

Background Comparison not Performed[1]

- Antimony
- Selenium
- Tin

2.5 Subsurface Soil Data Used in the ERA

For the subsurface soil data set, the MDCs for arsenic, nickel, and selenium exceed the prairie dog ESL and were carried forward into the statistical background comparison step. The results of the statistical comparison of the UWNEU subsurface soil data to background data are presented in Table A3.2.9, and the summary statistics for background and UWNEU subsurface soil data are shown in Table A3.2.10.

The results of the statistical comparisons of the surface soil data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Nickel

Background Comparison not Performed[1]

- Selenium

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil and subsurface soil with concentrations that are statistically greater than background, or for which background comparisons were not performed, are evaluated further by comparing the UWNEU EPCs to the limiting threshold (tESLs). The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)] for small home-range receptors, the UCL for large home-range receptors, or the MDC in the event that the UCL or UTL is greater than the MDC.

3.1 ECOIs in Surface Soil

Barium, cobalt, selenium, and thallium in surface soil (non-PMJM) were eliminated from further consideration because the upper-bound EPCs are not greater than the tESLs. Aluminum, antimony, boron, copper, molybdenum, nickel, silver, tin, vanadium, and zinc, along with three organics (bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total PCBs), have upper-bound EPCs greater than the tESLs and are evaluated in the professional judgment evaluation screening step (Section 4.0).

3.2 ECOIs in Subsurface Soil

Selenium in subsurface soil was eliminated from further consideration because the upper-bound EPC is not greater than the tESL. There are no analytes carried forward into professional judgment for subsurface soils.

4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the COC and ECOPC selection processes for the HHRA and ERA, respectively. Based on the weight of evidence evaluated in the professional judgment step, PCOCs and ECOIs are either included for further evaluation as COCs/ECOPCs in the risk characterization step or are excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS background and regional background datasets (see Table A3.4.1 for a summary of

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[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release; this is a highly unlikely probability.

regional background data)[3], and risk potential. For PCOCs or ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above. It is concluded that these analytes are COCs/ECOPCs, and they are carried forward into risk characterization. For the other PCOCs and ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8 of the RI/FS Report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following PCOCs/ECOIs are evaluated further in the professional judgment step for UWNEU:

- Surface soil/surface sediment (HHRA)
  - Arsenic
  - Benzo(a)pyrene
- Subsurface soil/subsurface sediment (HHRA)
  - Radium-228
- Surface soil for non-PMJM receptors (ERA)
  - Aluminum
  - Antimony
  - Boron
  - Copper
  - Molybdenum
  - Nickel
  - Silver
  - Tin
  - Vanadium

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states provides regional benchmarks for naturally-occurring metals in soil. The comparison of RFETS's soil data to these regional benchmarks is only performed for non-PMJM professional judgment because the PMJM habitat is restricted to the front range of Colorado.

  - Zinc
  - Bis(2-ethylhexyl)phthalate
  - Di-n-butylphthalate
  - Total PCBs
- Surface soil for PMJM receptors (ERA)
  - Antimony
  - Nickel
  - Selenium
  - Tin
  - Vanadium
  - Zinc
- Subsurface soil (ERA)

  No ECOIs were found to be statistically greater than background or above an ESL in accordance with the ECOPC selection process; therefore, no ECOIs in subsurface soil are evaluated using professional judgment.

The following sections provide the professional judgment evaluations, by analyte and by medium, for the PCOCs/ECOIs listed above.

4.1 Aluminum

Aluminum has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine whether aluminum should be retained for risk characterization are summarized below.

4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for aluminum to have been released into RFETS soil because of the large aluminum metal inventory and presence of aluminum in waste generated during former operations. However, the historical sources are remote from the UWNEU. Therefore, aluminum is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.1.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that aluminum concentrations in UWNEU surface soil reflect variations in naturally occurring aluminum.

4.1.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for natural log transformed aluminum concentration data in surface soil (Figure A3.4.1) suggests the presence of a single population, which is indicative of background conditions. The highest aluminum concentrations appear to be asymptotically approaching a maximum concentration.

4.1.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Aluminum concentrations in surface soil samples at the UWNEU range from 5,020 to 24,100 mg/kg, with a mean concentration of 12,192 mg/kg and a standard deviation of 4,122 mg/kg. Aluminum concentrations in the background data set range from 4,050 to 17,100 mg/kg, with a mean concentration of 10,203 mg/kg and a standard deviation of 3,256 mg/kg (Table A3.2.6). The concentrations of aluminum in surface soil samples at the UWNEU are slightly elevated compared to background, but the data populations overlap considerably.

Aluminum concentrations reported in surface soil samples at the UWNEU are well within the range for aluminum in soils of Colorado and the bordering states (5,000 to 100,000 mg/kg, with mean concentration of 50,800 mg/kg and a standard deviation of 23,500 mg/kg) (Table A3.4.1).

4.1.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for aluminum in the UWNEU (19,600 mg/kg) exceeds the no observed adverse effect level (NOAEL) ESL for only one receptor group, terrestrial plants (50 mg/kg). However, U.S. Environmental Protection Agency (EPA) Ecological Soil Screening Level (Eco-SSL) guidance (EPA 2003) for aluminum recommends that aluminum should not be considered an ECOPC for soils at sites where the soil pH exceeds 5.5 due to its limited bioavailability in non-acidic soils. The average pH value for RFETS surface soils is 8.2. Aluminum concentrations in the UWNEU show a distribution similar to site-wide background concentrations and have no identified source area in the UWNEU. Therefore, these concentrations are unlikely to result in risk concerns for wildlife populations.

4.1.6 Conclusion

The weight of evidence presented above shows that aluminum concentrations in UWNEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge; a spatial distribution that suggests aluminum is naturally occurring; a probability plot that suggests the presence of a single population, which is also indicative of background conditions; UWNEU concentrations that are well within regional background levels; and UWNEU concentrations that are unlikely to result in risk concerns for wildlife populations. Aluminum is not considered an ECOPC in surface soil for the UWNEU and, therefore, is not further evaluated quantitatively.

4.2 Antimony

Antimony has concentrations statistically greater than background in surface soil in PMJM habitat in the UWNEU. Antimony also has an EPC in surface soil (for non-PMJM receptors) greater than the tESL. Therefore, antimony in surface soil (PMJM receptor), and surface soil (non-PMJM receptor) was carried forward to the professional judgment step. The lines of evidence used to determine whether antimony should be retained for risk characterization are summarized below.

4.2.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates antimony is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.2.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that there are elevated concentrations of antimony near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that there are elevated concentrations of antimony near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.2.3 Conclusion

Antimony in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) exist within historical IHSSs. Antimony was used in limited quantities during historical RFETS operations, which would indicate it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, antimony is carried forward into the risk characterization step, recognizing that its classification as a COC/ECOPC is uncertain.

Antimony in surface soil concentrations is being carried forward into the ecological PMJM risk characterization because elevated concentrations (more than three times greater than the ESL) exist within one or more PMJM habitat patches. Antimony is unlikely to be an ECOPC at the UWNEU based on low metal inventories at RFETS, use as a laboratory standard only, and/or limited identification as a constituent in wastes generated at RFETS. However, due to the exceedances in the PMJM habitat patches, antimony is retained as an ECOPC for further evaluation in the risk characterization.

4.3 Arsenic

Arsenic has concentrations statistically greater than background in surface soil/surface sediment and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine whether arsenic should be retained for risk characterization are summarized below.

4.3.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.3.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that arsenic concentrations in UWNEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

4.3.3 Pattern Recognition

Surface Soil/Surface Sediment

The probability plot for arsenic in surface soil (Figure A3.4.2) suggests the presence of a single population, which is indicative of background conditions.

4.3.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Arsenic concentrations in surface soil/surface sediment samples at the UWNEU range from 1.10 to 10.2 mg/kg, with a mean concentration of 5.15 mg/kg and a standard deviation of 1.79 mg/kg. Arsenic concentrations in the background data set range from 0.27 to 9.6 mg/kg, with a mean concentration of 3.42 mg/kg and a standard deviation of 2.55 mg/kg (Table A3.2). The range of arsenic concentrations in the UWNEU and background samples overlap considerably, with only three detections out of 151 samples having concentrations greater than the background MDC.

Arsenic concentrations reported in surface soil samples at the UWNEU are well within the range for arsenic in soils of Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg). Table A3.4.1 summarizes the ranges of metals in soils of Colorado and the bordering states.

4.3.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The arsenic MDC for surface soil/surface sediment is 11.0 mg/kg and the UCL is 5.61 mg/kg. The UCL is less than three times greater than the PRG (2.41 mg/kg), with 138 of the 151 detections greater than the PRG. Because the PRG is based on an excess carcinogenic risk of 1E-06, the cancer risk based on the UCL concentration is less than 3E-06 and is well within the National Contingency Plan (NCP) risk range of 1E-06 to 1E-04. Arsenic was detected in 67 of 73 background samples, and detected concentrations in 39 of the 67 samples exceeded the PRG. The background UCL for arsenic in surface soil/surface sediment is 4.03 mg/kg (Appendix A, Volume 2, Attachment 9 of the RI/FS Report), which equates to a cancer risk of 2E-06. Therefore, the excess cancer risks to the WRW from exposure to arsenic in surface soil/surface sediment in the UWNEU are similar to background risk.

4.3.6 Conclusion

The weight of evidence presented above shows that arsenic concentrations in UWNEU surface soil/surface sediment are not likely to be a result of historical site-related activities based on process knowledge; spatial distributions that suggest arsenic is naturally occurring; probability plots that suggest the presence of single arsenic data populations, which are also indicative of background conditions; UWNEU concentrations that are well within regional background levels; and UWNEU concentrations that are unlikely to result in risks to humans significantly above background risks. Arsenic is not considered a COC in surface soil/surface sediment for the UWNEU and, therefore, is not further evaluated quantitatively.

4.4 Benzo(a)pyrene

Benzo(a)pyrene had a UCL in surface soil/surface sediment greater than the PRG and was carried forward to the professional judgment step. A decision could not be made about whether concentrations in samples collected from the UWNEU are significantly elevated versus background because the background comparison is not performed for organics. The lines of evidence used to determine if benzo(a)pyrene should be retained as a COC are summarized below.

4.4.1 Summary of Process Knowledge

Polynuclear aromatic hydrocarbons (PAHs), including benzo(a)pyrene, are ubiquitous in the environment, and typical concentrations in urban soil range from 165 to 220 micrograms per kilogram (µg/kg) (ATSDR 1995). Benzo(a)pyrene has not been directly associated with historical IHSSs within the UWNEU, but could be associated with traffic, pavement degradation, or pavement operations in some portions of the UWNEU and in the nearby Industrial Area (IA). For example, a sample collected from the western portion of the UWNEU, near the location of a former road, had benzo(a)pyrene concentrations greater than three times the PRG (a MDC of 1,300 µg/kg versus the PRG of 379 µg/kg). During the peak traffic years (1990-2004), Geographic Information System (GIS) coverage shows approximately 6,720,800 square feet of asphalt surface area at RFETS, primarily in the IA.

4.4.2 Summary of Spatial Trends

Surface Soil/Surface Sediment

Benzo(a)pyrene was detected in 21 of 66 samples, with concentrations ranging from 48 to 1,300 µg /kg. Three of the 21 detections exceed the PRG (out of 21 detections), including one sample that is greater than three times the PRG. These exceedances are located near the IA or historical IHSSs (Figure A3.4.3).

4.4.3 Conclusion

Although benzo(a)pyrene is not necessarily associated with site activities, a decision could not be made whether concentrations in samples collected from the UWNEU are significantly elevated compared to background because the background comparison is not performed for organics. However, as noted above, benzo(a)pyrene is detected in urban soils. Because the exceedances of PRGs are located near historical IHSSs in UWNEU, as a conservative measure, benzo(a)pyrene was identified as a COC and carried forward into risk characterization.

4.5 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate had an upper-bound EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and was carried forward to the professional judgment step. A decision could not be made about whether concentrations in samples collected from the UWNEU are significantly elevated versus background because the background comparison is not performed for organics. The lines of evidence used to determine if bis(2-ethylhexyl)phthalate should be retained for risk characterization are summarized below.

4.5.1 Summary of Process Knowledge

There are no documented operations or activities that occurred in UWNEU involving the use of bis(2-ethylhexyl)phthalate (CDH 1992; DOE 1992, 1995). Therefore, the potential for bis(2-ethylhexyl)phthalate to be present in UWNEU surface soil as a result of historical site-related activities is unlikely.

4.5.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Bis(2-ethylhexyl)phthalate was detected in 41 percent of the UWNEU surface soil samples. The detections range from 44 to 3,600 mg/kg, with a mean concentration of 421 µg/kg and standard deviation of 853 µg/kg. As shown in Figure A3.4.4, detections more than three times the ESL of 136 μg/kg occur at two locations near a historical IHSS boundary.

4.5.3 Conclusion

Bis(2-ethylhexyl)phthalate in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization as an ECOPC because elevated concentrations (greater than three times the ESL) were measured in surface soil samples collected near historical IHSSs.

4.6 Boron

For boron in surface soil, a statistical comparison between UWNEU and RFETS background data could not be performed because RFETS background surface soil samples were not analyzed for boron. Boron has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if boron should be retained for risk characterization are summarized below.

4.6.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.6.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that boron concentrations in UWNEU surface soil reflect variations in naturally occurring boron.

4.6.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for the natural logarithm of boron concentrations (Figure A3.4.5) suggests a single background population with some variability above and below the line. The variability is likely due to the small sample size which also makes it difficult to draw a reliable conclusion about the nature of the distribution.

4.6.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for boron in surface soil within Colorado and the bordering states is 20 to 150 mg/kg, with a mean concentration of 27.9 mg/kg and a standard deviation of

19.7 mg/kg (Table A3.4.1). Boron concentrations reported in surface soil samples at the UWNEU range from 1.20 to 10.4 mg/kg, with a mean concentration of 4.74 mg/kg and a standard deviation of 2.44 mg/kg (Table A3.2.6). The range of concentrations of boron in surface soil is well within the range for boron in soils of Colorado and the bordering states.

4.6.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for boron in the UWNEU (10.6 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 30 to 6,070 mg/kg. Site-specific background data for boron were not available, but the UTL did not exceed the low end (20 mg/kg) of the background range presented in Shacklette and Boerngen (1984). This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is well below expected background concentrations, and MDCs above the NOAEL ESL are not likely to be indicative of site-related risk to the terrestrial plant community in the UWNEU. Kabata-Pendias and Pendias (1992) indicate soil with boron concentrations equal to 0.3 mg/kg is critically deficient in boron, and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5-mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. No boron Eco-SSLs are currently available. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the UTL, boron is unlikely to present a risk to terrestrial receptors in the UWNEU.

4.6.6 Conclusion

The weight of evidence presented above shows that boron concentrations in UWNEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge; a spatial distribution that suggests boron is naturally occurring; a probability plot that suggests the presence of a single population, which is also indicative of background conditions; UWNEU concentrations that are well within regional background levels; and UWNEU concentrations that are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the UWNEU and, therefore, is not further evaluated quantitatively.

4.7 Copper

Copper has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. In addition, copper in surface soil (for PMJM receptors) has concentrations statistically greater than background. The lines of evidence used to determine whether copper should be retained for risk characterization are summarized below.

4.7.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for copper to have been released into RFETS soil because of the moderate copper metal inventory and presence of copper in waste generated during former operations. Therefore, copper may be present in RFETS soil as a result of historical site-related activities, however, uses or releases in the UWNEU have not been identified.

4.7.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates elevated copper concentrations located near a historical IHSS in UWNEU.

4.7.3 Conclusion

Copper in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured within or near historical IHSSs in the UWNEU. Copper also was used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

4.8 Di-n-butylphthalate

Di-n-butylphthalate has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if di-n-butylphthalate should be retained for risk characterization are summarized below.

4.8.1 Summary of Process Knowledge

There are no documented operations or activities that occurred in UWNEU involving the use of di-n-butylphthalate (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for di-n-butylphthalate in UWNEU surface soil as a result of historical site-related activities is unlikely.

4.8.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Di-n-butylphthalate was detected only twice (79 ug/kg and 50 ug/kg), and in both instances the concentration exceeds the ESL of 16 ug/kg. As shown in Figure A3.4.6, the locations of the detections are near a historical IHSS and, therefore, cannot be eliminated as an ECOPC.

4.8.3 Conclusion

Di-n-butylphthalate in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization as an ECOPC because elevated concentrations (greater than three times the ESL) exist in surface soil samples collected near historical IHSSs.

4.9 Molybdenum

Molybdenum had an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine whether molybdenum should be retained for risk characterization are summarized below.

4.9.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.9.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated molybdenum concentrations in UWNEU were located near a historical IHSS and, therefore, cannot be eliminated as an ECOPC.

4.9.3 Conclusion

Molybdenum in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured, including a number of exceedances, but only within a historical IHSS. Molybdenum was used in limited quantities during historical RFETS operations, which would indicate it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, it is being carried forward into the risk characterization, recognizing that its classification as ECOPC is uncertain.

4.10 Nickel

Nickel had an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. In addition, nickel in surface soil (for PMJM receptors) had concentrations statistically greater than background, and was carried forward to the professional judgment step. The lines of evidence used to determine whether nickel should be retained for risk characterization are summarized below.

4.10.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for nickel to have been released into RFETS soil because of the moderate nickel metal inventory and presence of nickel in waste generated during former operations. However, uses and releases in the UWNEU have not been identified.

4.10.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated nickel concentrations in UWNEU surface soil were located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated nickel concentrations in UWNEU surface soil in PMJM habitat were located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.10.3 Conclusion

Nickel in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured and are within or near historical IHSSs.

Nickel in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations (more than three times greater than the ESL) are within one or more PMJM habitat patches. Nickel is also used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

4.11 Total PCBs

Total PCBs has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. A decision could not be made whether concentrations in samples collected from the UWNEU are significantly elevated versus background because the background comparison is not performed for organics. The lines of evidence used to determine whether total PCBs should be retained for risk characterization are summarized below.

4.11.1 Summary of Process Knowledge

There are no documented operations or activities that occurred in UWNEU involving the use of total PCB (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for total PCBs to be present in UWNEU surface soil as a result of historical site-related activities is unlikely.

4.11.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Total PCB was detected in 9 percent of the 44 surface samples collected from the UWNEU, with a concentration range of 70 µg/kg to 270 µg/kg and a mean concentration of 175 mg/kg. One sample with concentrations three times the ESL of 42 µg/kg is located near a historical IHSS (Figure A3.4.7) and, therefore, cannot be eliminated as an ECOPC.

4.11.3 Conclusion

Total PCBs in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization as an ECOPC because elevated concentrations (greater than three times the ESL) were measured in surface soil samples collected near historical IHSSs.

4.12 Radium-228

Radium-228 has activities statistically greater than background in subsurface soil/subsurface sediment and was carried forward to the professional judgment step. The lines of evidence used to determine whether radium-228 should be retained for risk characterization are summarized below.

4.12.1 Summary of Process Knowledge

The ChemRisk Task 1 Report (CDH 1991) did not identify radium-228 as a radionuclide used at RFETS, and no radium-228 waste was reported to have been generated. It is unlikely that radium-228 is present in soil at RFETS as a result of historical site-related activities.

4.12.2 Evaluation of Spatial Trends

Subsurface Soil/Subsurface Sediment

As shown in Figure A3.4.8, radium-228 activities exceed the PRG of 0.111 picocuries per gram (pCi/g) at locations throughout the UWNEU. There are no locations where the radium-228 activities exceeds the background MDC. Therefore, it appears that radium-228 activities in UWNEU surface soil reflect variations in naturally occurring radium-228.

4.12.3 Pattern Recognition

Subsurface Soil/Subsurface Sediment

The probability plot for radium-228 activities suggests a single population, which is indicative of background conditions (Figure A3.4.9). The probability plot indicates a background population ranging from about 1.7 to 2.04 pCi/g, with two samples below the background line and one sample above the line.. The two samples below the background line are SD00261WC (0.04 pCi/g) and SD00241WC (0.82 pCi/g), and the sample above the line is SD00284WC (2.40 pCi/g).

4.12.4 Comparison to RFETS Background and Other Background Data Sets

Subsurface Soil/Subsurface Sediment

Radium-228 activities in subsurface soil/subsurface sediment samples at the UWNEU range from 1.28 to 1.87 pCi/g, with a mean concentration of 1.57 pCi/g and a standard deviation of 0.187 pCi/g. The radium-228 activities in the background data set range from 1.00 to 2.10 pCi/g, with a mean concentration of 1.45 pCi/g and a standard deviation of 0.320 pCi/g (Table A3.2.4). The range of activities of radium-228 in subsurface soil/subsurface sediment samples at the UWNEU and background overlap considerably and all of the detections are less than the background MDC.

4.12.5 Risk Potential for HHRA

The radium-228 MDC for subsurface soil/subsurface sediment is 2.68 pCi/g and the UCL is 2.00 pCi/g. The UCL is nearly the same as the PRG (1.28 pCi/g), with all of the detections greater than the PRG. However, the PRG is based on an excess carcinogenic risk of 10^{-6}; therefore, the risk to human health is well within the NCP risk range of 10^{-6} to 10^{-4}. Furthermore, because radium-228 activities in the UWNEU appear to represent naturally occurring conditions and because radium-228 was not used at the site, this risk is not likely associated with any releases from RFETS.

4.12.6 Conclusion

The weight of evidence presented above shows that radium-228 activities in UWNEU subsurface soil/subsurface sediment are not likely to be a result of historical site-related activities based on process knowledge; a spatial distribution indicative of naturally occurring radium-228; a probability plot that suggests the presence of a single population, which is also indicative of background conditions; and UWNEU activities that are unlikely to result in risks to humans significantly above background risks. Radium-228 is not considered a COC in subsurface soil/subsurface sediment for the UWNEU and, therefore, is not further evaluated quantitatively.

4.13 Selenium

Selenium in surface soil (for PMJM receptors) has concentrations statistically greater than background, and was carried forward to the professional judgment step. The lines of evidence used to determine whether selenium should be retained for risk characterization are summarized below.

4.13.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, based on process knowledge, selenium is unlikely to be present in RFETS soils as a result of historical site related activities. However, there are no IHSSs in the UWNEU. Therefore, selenium is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.13.2 Evaluation of Spatial Trends

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that selenium concentrations in UWNEU surface soil in PMJM habitat reflect variations in naturally occurring selenium.

4.13.3 Pattern Recognition

Surface Soil (PMJM)

The log-probability plot, which includes both the detected and nondetected (multiple detection limits) selenium concentrations (Figure A3.4.10) was not resolvable. An evaluation of a data set that is highly censored with multiple detection limits using a log-probability plot is not reliable.

4.13.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (PMJM)

Selenium concentrations in surface soil samples associated with the PMJM patches at the UWNEU range from 0.43 to 0.700 mg/kg, with a mean concentration of 0.466 mg/kg and a standard deviation of 0.577 mg/kg. Selenium concentrations in the background data set range from 0.680 to 1.40 mg/kg, with a mean concentration of 0.628 mg/kg and a standard deviation of 0.305 mg/kg (Table A3.2.8). The range of concentrations of selenium in surface soil samples at the UWNEU and background overlap considerably and all of the detections are less than the background MDC.

Selenium concentrations reported in surface soil samples at the UWNEU are above the range for selenium in soils of Colorado and the bordering states (0.1 to 0.43 mg/kg, with a mean concentration of 0.349 mg/kg and a standard deviation of 0.415 mg/kg) (Table A3.4.1).

4.13.5 Risk Potential for Plants and Wildlife

Surface Soil (PMJM)

The UCL for selenium in PMJM habitat in the UWNEU (0.786 mg/kg) exceeds the NOAEL ESL for PMJM (0.421 mg/kg). All five of the detects from surface soil samples collected in PMJM habitat had concentrations greater than the NOAEL ESL for the PMJM. The PMJM ESL is less than all background samples. In addition, the UCL (0.786 mg/kg) in PMJM habitat is approximately half as much as the site background MDC (1.4 mg/kg) indicating that the selenium concentrations in the UWNEU are most likely due to local variations in natural sources. No selenium Eco-SSLs are currently available for any receptor (the selenium Eco-SSL document is "pending").

4.13.6 Conclusion

The weight of evidence presented above shows that selenium concentrations in UWNEU surface soil (PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, a spatial distribution indicative of naturally occurring selenium, and UWNEU concentrations that are near regional background levels. Although the log-probability plot was inconclusive, selenium is not considered an ECOPC in surface soil for the UWNEU and, therefore, is not further evaluated quantitatively.

4.14 Silver

Silver has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and was therefore carried forward to the professional judgment step. The lines of evidence used to determine whether silver should be retained for risk characterization are summarized below.

4.14.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for silver to have been released into RFETS soil due to the moderate silver metal inventory during former operations. However, the historical sources are remote from the UWNEU. Therefore, silver is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.14.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevate silver concentrations in UWNEU surface soil are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.14.3 Conclusion

Silver in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured and are within or near historical IHSSs. Silver also was used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

4.15 Tin

For tin in surface soil, a statistical comparison between UWNEU (non-PMJM and PMJM) and RFETS background data could not be performed because tin was not detected in RFETS background surface soil samples. Tin has an EPC in surface soil (non-

PMJM) greater than the tESL. The lines of evidence used to determine whether tin should be retained for risk characterization are summarized below.

4.15.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for tin to have been released into RFETS soil due to the moderate tin metal inventory during former operations. However, no uses or releases have been identified in the UWNEU. Therefore, tin is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.15.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated tin concentrations in UWNEU surface soil are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated tin concentrations in UWNEU surface soil in PMJM habitat are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.15.3 Conclusion

Tin in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured within or near historical IHSSs. Tin also was used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

Tin in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations (more than three times greater than the ESL) are within one or more PMJM habitat patches. Tin was also used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

4.16 Vanadium

Vanadium has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. In addition, vanadium in surface soil (for PMJM receptors) has concentrations statistically greater than background and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine whether vanadium should be retained for risk characterization are summarized below.

4.16.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates vanadium is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.16.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated vanadium concentrations in UWNEU surface soil are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated vanadium concentrations in UWNEU surface soil in PMJM habitat are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.16.3 Conclusion

Vanadium in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured within or near historical IHSSs. Vanadium was used in limited quantities during historical RFETS operations, indicating it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, it is carried forward into the risk characterization, recognizing that its classification as ECOPC is uncertain.

Vanadium in surface soil concentrations is being carried forward into the ecological PMJM risk characterization because elevated concentrations (more than three times greater than the ESL) are within one or more PMJM habitat patches located near a historical IHSS. Vanadium is unlikely to be an ECOPC at the UWNEU based on low metal inventories at RFETS, use as a laboratory standard only, and/or limited identification as a constituent in wastes generated at RFETS. However, due to the exceedances in the PMJM habitat patches, vanadium is retained as an ECOPC for further evaluation in the risk characterization.

4.17 Zinc

Zinc has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. In addition, zinc has an EPC in surface soil (for non-PMJM receptors) greater than the tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if zinc should be retained for risk characterization are summarized below.

4.17.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for zinc to have been released into RFETS soil due to the moderate zinc metal inventory and the presence of zinc in waste generated during former operations. However, no uses or releases have been identified in the UWNEU. Therefore, zinc is unlikely to be present in UWNEU soil as a result of historical site-related activities.

4.17.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated zinc concentrations in UWNEU surface soil are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated zinc concentrations in UWNEU surface soil are located near historical IHSSs and, therefore, cannot be eliminated as an ECOPC.

4.17.3 Conclusion

Zinc in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than ten times the ESL) were measured and/or are within or near historical IHSSs. Zinc also was used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

Zinc is being carried forward into the ecological PMJM risk characterization because elevated concentrations (more than three times greater than the ESL) are within one or more PMJM habitat patches. Zinc was also used at RFETS and/or identified in wastes, although uses and releases in the UWNEU have not been identified.

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TABLES

Table A3.2.1
Statistical Distributions and Comparison to Background for UWNEU Surface Soil/ Surface Sediment

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background Data Set			UWNEU Data Set (excluding background samples)			Test	1 - p	Statistically Greater than Background?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	**73**	**GAMMA**	**92**	**130**	**NORMAL**	**100**	**WRS**	**7.85E-08**	**Yes**
Cesium-137	105	NON-PARAMETRIC	100	62	GAMMA	100	WRS	1.000	No
Radium-228	40	GAMMA	100	46	NON-PARAMETRIC	100	WRS	0.222	No

WRS = Wilcoxon Rank Sum
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.2

Summary Statistics for Background and UWNEU Surface Soil/ Surface Sediment[a]

Analyte	Background					UWNEU (excluding background samples)				
	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Inorganics (mg/kg)										
Arsenic	73	0.270	9.60	3.42	2.55	130	1.10	10.2	5.15	1.79
Organics (µg/kg)										
Benzo(a)pyrene	62	120	900	389	217	53	48.0	1,300	281	239
Radionuclides (pCi/g)										
Cesium-137	105	-0.027	1.80	0.692	0.492	62	0.003	0.680	0.227	0.186
Radium-228	40	0.200	4.10	1.60	0.799	46	0.040	2.40	1.54	0.359

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

N/A = Not applicable; site and/or background detection frequency less than 20%.

Table A3.2.3
Statistical Distributions and Comparison to Background for UWNEU Subsurface Soil/ Subsurface Sediment

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Radionuclides									
Radium-228	**31**	**GAMMA**	**100**	**14**	**NORMAL**	**100**	**WRS**	**0.081**	**Yes**

WRS = Wilcoxon Rank Sum

N/A = Not applicable; site and/or background detection frequency less than 20%.

Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.4
Summary Statistics for Background and UWNEU Subsurface Soil/ Subsurface Sediment

Analyte	Background					UWNEU (excluding background samples)				
	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Radionuclides (pCi/g)										
Radium-228	31	1.00	2.10	1.45	0.320	14	1.28	1.87	1.57	0.187

N/A = Not applicable; site and/or background detection frequency less than 20%.

Table A3.2.5
Statistical Distributions and Comparison to Background for UWNEU Surface Soil (non-PMJM Receptor)

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Inorganics (mg/kg)									
Aluminum	**20**	**NORMAL**	**100**	**90**	**GAMMA**	**100**	**WRS**	**0.034**	**Yes**
Antimony	**20**	**NON-PARAMETRIC**	**0**	**84**	**NON-PARAMETRIC**	**44**	**N/A**	**N/A**	**N/A**
Arsenic	20	NORMAL	100	90	NORMAL	100	t-Test_N	0.994	No
Barium	**20**	**NORMAL**	**100**	**90**	**NORMAL**	**100**	**t-Test_N**	**3.23E-05**	**Yes**
Boron	**N/A**	**N/A**	**N/A**	**13**	**NORMAL**	**100**	**N/A**	**N/A**	**N/A**
Cadmium	20	NON-PARAMETRIC	65	90	NON-PARAMETRIC	34	WRS	0.914	No
Chromium	20	NORMAL	100	90	NORMAL	87	t-Test_N	0.183	No
Cobalt	**20**	**NORMAL**	**100**	**90**	**NON-PARAMETRIC**	**98**	**WRS**	**0.034**	**Yes**
Copper	**20**	**NON-PARAMETRIC**	**100**	**90**	**NON-PARAMETRIC**	**99**	**WRS**	**9.40E-06**	**Yes**
Lead	20	NORMAL	100	90	GAMMA	100	WRS	1.000	No
Lithium	20	NORMAL	100	86	GAMMA	74	WRS	0.372	No
Manganese	20	NORMAL	100	90	NON-PARAMETRIC	100	WRS	0.407	No
Mercury	20	NON-PARAMETRIC	40	86	NON-PARAMETRIC	37	WRS	1.000	No
Molybdenum	**20**	**NORMAL**	**0**	**87**	**NON-PARAMETRIC**	**17**	**N/A**	**N/A**	**N/A**
Nickel	**20**	**NORMAL**	**100**	**90**	**NORMAL**	**98**	**t-Test_N**	**1.18E-05**	**Yes**
Selenium	**20**	**NON-PARAMETRIC**	**60**	**90**	**NON-PARAMETRIC**	**17**	**N/A**	**N/A**	**N/A**
Silver	**20**	**NORMAL**	**0**	**88**	**NON-PARAMETRIC**	**20**	**N/A**	**N/A**	**N/A**
Thallium	**14**	**NORMAL**	**0**	**88**	**NON-PARAMETRIC**	**35**	**N/A**	**N/A**	**N/A**
Tin	**20**	**NORMAL**	**0**	**87**	**NON-PARAMETRIC**	**7**	**N/A**	**N/A**	**N/A**
Vanadium	**20**	**NORMAL**	**100**	**90**	**GAMMA**	**100**	**WRS**	**4.87E-04**	**Yes**
Zinc	**20**	**NORMAL**	**100**	**90**	**GAMMA**	**100**	**WRS**	**0.001**	**Yes**

WRS = Wilcoxon Rank Sum.
t-Test_N = Student's t-test using normal data.
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.6
Summary Statistics for Background and UWNEU Surface Soil (non-PMJM)

Analyte	Background					UWNEU (excluding background samples)				
	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Inorganics (mg/kg)										
Aluminum	20	4,050	17,100	10,203	3,256	90	5,020	24,100	12,192	4,122
Antimony	20	N/A	N/A	0.279	0.078	84	0.460	43.6	10.8	9.79
Arsenic	20	2.30	9.60	6.09	2.00	90	1.80	9.60	4.96	1.74
Barium	20	45.7	134	102	19.4	90	40.4	272	148	48.3
Boron	N/A	N/A	N/A	N/A	N/A	13	1.20	10.4	4.74	2.44
Cadmium	20	0.670	2.30	0.708	0.455	90	0.100	2.70	0.595	0.414
Chromium	20	5.50	16.9	11.2	2.78	90	5.00	31.1	12.3	4.89
Cobalt	20	3.40	11.2	7.27	1.79	90	1.90	18.8	8.41	2.75
Copper	20	5.20	16.0	13.0	2.58	90	4.50	61.6	18.8	9.00
Lead	20	8.60	53.3	33.5	10.5	90	8.20	62.0	24.5	11.5
Lithium	20	4.80	11.6	7.66	1.89	86	3.60	14.2	8.06	2.98
Manganese	20	129	357	237	63.9	90	94.4	823	258	119
Mercury	20	0.090	0.120	0.072	0.031	86	0.006	0.210	0.044	0.040
Molybdenum	20	N/A	N/A	0.573	0.184	87	0.160	19.1	1.92	2.02
Nickel	20	3.80	14.0	9.60	2.59	90	4.20	28.3	13.8	4.08
Selenium	20	0.680	1.40	0.628	0.305	90	0.270	0.790	0.296	0.134
Silver	20	N/A	N/A	0.207	0.007	88	0.180	8.90	0.899	1.13
Thallium	14	N/A	N/A	0.414	0.015	88	0.230	1.20	0.279	0.202
Tin	20	N/A	N/A	2.06	0.410	87	18.6	33.8	8.69	6.54
Vanadium	20	10.8	45.8	27.7	7.68	90	14.1	75.9	35.7	11.3
Zinc	20	21.1	75.9	49.8	12.2	90	20.8	120	60.2	14.9
Organics (µg/kg)										
bis(2-ethylhexyl)phthalate	N/A	N/A	N/A	N/A	N/A	17	44.0	3,600	421	853
Di-n-butylphthalate	N/A	N/A	N/A	N/A	N/A	17	50.0	79.0	198	52.8
Aroclor-1254	N/A	N/A	N/A	N/A	N/A	44	28.0	110	86.5	20.0
Aroclor-1260	N/A	N/A	N/A	N/A	N/A	44	42.0	160	88.7	20.9

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.
N/A = Not available.
ND = Analyte not detected.

Table A3.2.7
Statistical Distributions and Comparison to Background for UWNEU Surface Soil (PMJM)

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Inorganics (mg/kg)									
Antimony	**20**	**NON-PARAMETRIC**	**0**	**61**	**NON-PARAMETRI**	**34**	**N/A**	**N/A**	**N/A**
Arsenic	20	NORMAL	100	62	NORMAL	100	t-Test_N	0.995	No
Cadmium	20	NON-PARAMETRIC	65	62	NON-PARAMETRIC	42	WRS	0.786	No
Chromium	20	NORMAL	100	62	NORMAL	100	t-Test_N	0.367	No
Manganese	20	NORMAL	100	62	NON-PARAMETRIC	100	WRS	0.500	No
Mercury	20	NON-PARAMETRIC	40	61	NON-PARAMETRIC	25	WRS	1.000	No
Nickel	**20**	**NORMAL**	**100**	**62**	**NORMAL**	**100**	**t-Test_N**	**8.91E-07**	**Yes**
Selenium	**20**	**NON-PARAMETRIC**	**60**	**62**	**NON-PARAMETRI**	**11**	**N/A**	**N/A**	**N/A**
Tin	**20**	**NORMAL**	**0**	**61**	**NON-PARAMETRI**	**18**	**N/A**	**N/A**	**N/A**
Vanadium	**20**	**NORMAL**	**100**	**62**	**NON-PARAMETRI**	**100**	**WRS**	**0.013**	**Yes**
Zinc	**20**	**NORMAL**	**100**	**62**	**NON-PARAMETRI**	**100**	**WRS**	**6.05E-05**	**Yes**

WRS = Wilcoxon Rank Sum.
t-Test_N = Student's t-test using normal data.
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.8
Summary Statistics for Background and UWNEU Surface Soil (PMJM)[a]

Analyte	Background					UWNEU (excluding background samples)				
	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Inorganics (mg/kg)										
Antimony	20	ND	ND	0.279	0.078	61	0.290	26.5	7.75	6.55
Arsenic	20	2.30	9.60	6.09	2.00	62	1.80	7.80	4.95	1.56
Cadmium	20	0.670	2.30	0.708	0.455	62	0.230	2.70	0.648	0.472
Chromium	20	5.50	16.9	11.2	2.78	62	2.20	20.6	11.5	3.69
Manganese	20	129	357	237	63.9	62	67.0	823	256	133
Mercury	20	0.090	0.120	0.072	0.031	61	0.024	0.340	0.051	0.053
Nickel	20	3.80	14.0	9.60	2.59	62	7.50	25.0	14.2	3.68
Selenium	20	0.680	1.40	0.628	0.305	62	0.430	0.700	0.466	0.577
Tin	20	ND	ND	2.06	0.410	61	2.90	29.7	7.34	5.69
Vanadium	20	10.8	45.8	27.7	7.68	62	12.1	75.9	33.1	11.1
Zinc	20	21.1	75.9	49.8	12.2	62	15.0	650	81.0	82.6

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.
ND = Analyte not detected.

Table A3.2.9
Statistical Distributions and Comparison to Background for UWNEU Subsurface Soil

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWNEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	45	NONPARAMETRIC	93	95	GAMMA	100	WRS	0.606	No
Nickel	44	GAMMA	100	95	NONPARAMETRIC	83	WRS	1.000	No
Selenium	**38**	**LOGNORMAL**	**0**	**85**	**NONPARAMETRIC**	**19**	**N/A**	**N/A**	**N/A**

WRS = Wilcoxon Rank Sum.

N/A = Not applicable; site and/or background detection frequency less than 20%.

Bold = Analyte retained for further consideration in the next COC selection step.

Table A3.2.10
Summary Statistics for Background and UWNEU Subsurface Soil[a]

Analyte	Background					UWNEU (excluding background samples)				
	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Inorganics (mg/kg)										
Arsenic	45	1.70	41.8	5.48	6.02	95	1.10	15.1	4.79	2.49
Nickel	44	4.30	54.2	20.9	11.1	95	5.20	190	15.7	19.8
Selenium	38	ND	ND	0.592	0.543	85	0.280	5.80	0.365	0.641

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.
ND = Nondetect.

Table A3.4.1

Summary of Element Concentrations in Colorado and Bordering States Surface Soil [a]

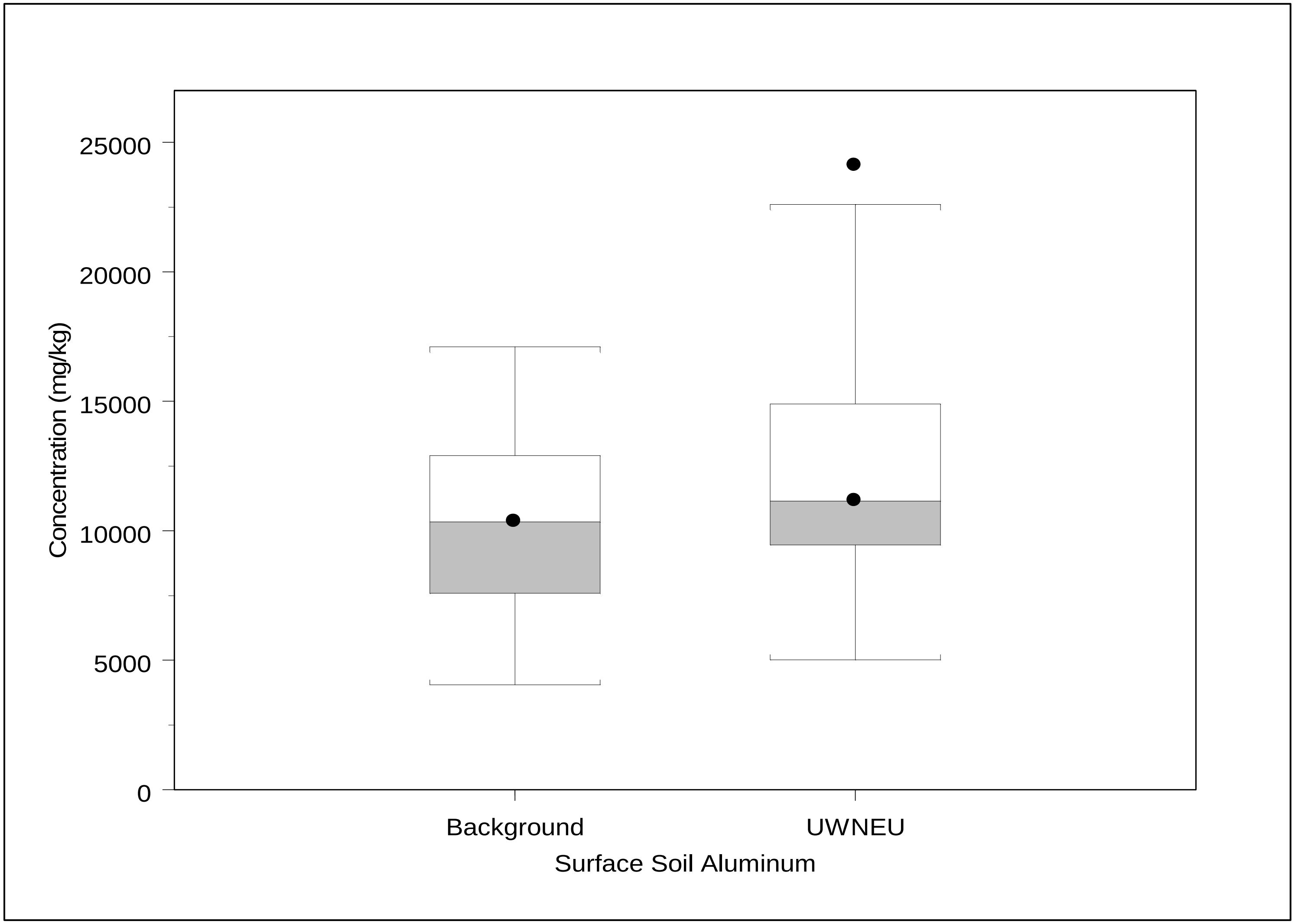
Analyte	Total Number of Results	Detection Frequency (%)	Range of Detected Values (mg/kg)	Average (mg/kg)[b]	Standard Deviation (mg/kg)[b]
Aluminum	303	100%	5,000 - 100,000	50,800	23,500
Antimony	84	15%	1.038 - 2.531	0.647	0.378
Arsenic	307	99%	1.224 - 97	6.9	7.64
Barium	342	100%	100 - 3,000	642	330
Beryllium	342	36%	1 - 7	0.991	0.876
Boron	342	67%	20 - 150	27.9	19.7
Bromine	85	51%	0.5038 - 3.522	0.681	0.599
Calcium	342	100%	0.055 - 32	3.09	4.13
Carbon	85	100%	0.3 - 10	2.18	1.92
Cerium	291	16%	150 - 300	90	38.4
Chromium	342	100%	3 - 500	48.2	41
Cobalt	342	89%	3 - 30	8.09	5.03
Copper	342	100%	2 - 200	23.1	17.7
Fluorine	264	97%	10 - 1,900	394	261
Gallium	340	99%	5 - 50	18.3	8.9
Germanium	85	100%	0.5777 - 2.146	1.18	0.316
Iodine	85	79%	0.516 - 3.487	1.07	0.708
Iron	342	100%	3,000 - 100,000	21,100	13,500
Lanthanum	341	66%	30 - 200	39.8	28.8
Lead	342	93%	10 - 700	24.8	41.5
Lithium	307	100%	5 - 130	25.3	14.4
Magnesium	341	100%	300 - 50,000	8,630	6,400
Manganese	342	100%	70 - 2,000	414	272
Mercury	309	99%	0.01 - 4.6	0.0768	0.276
Molybdenum	340	4%	3 - 7	1.59	0.522
Neodymium	256	23%	70 - 300	47.1	31.7
Nickel	342	96%	5 - 700	18.8	39.8
Niobium	335	63%	10 - 100	11.4	8.68
Phosphorus	249	100%	40 - 4,497	399	397
Potassium	341	100%	1,900 - 63,000	18,900	6,980
Rubidium	85	100%	35 - 140	75.8	25
Scandium	342	85%	5 - 30	8.64	4.69
Selenium	309	81%	0.1023 - 4.3183	0.349	0.415
Silicon	85	100%	149,340 - 413,260	302,000	61,500
Sodium	335	100%	500 - 70,000	10,400	6,260
Strontium	342	100%	10 - 2,000	243	212
Sulfur	85	16%	816 - 47,760	1,250	5,300
Thallium	76	100%	2.45 - 20.79	9.71	3.54
Tin	85	96%	0.117 - 5.001	1.15	0.772
Titanium	342	100%	500 - 7,000	2,290	1,350
Uranium	85	100%	1.11 - 5.98	2.87	0.883
Vanadium	342	100%	7 - 300	73	41.7
Ytterbium	330	99%	1 - 20	3.33	2.06
Yttrium	342	98%	10 - 150	26.9	18.1
Zinc	330	100%	10 - 2,080	72.4	159
Zirconium	342	100%	30 - 1,500	220	157

[a] Based on data from Shacklette and Boerngen 1984 for the states of Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming.

[b] One-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.

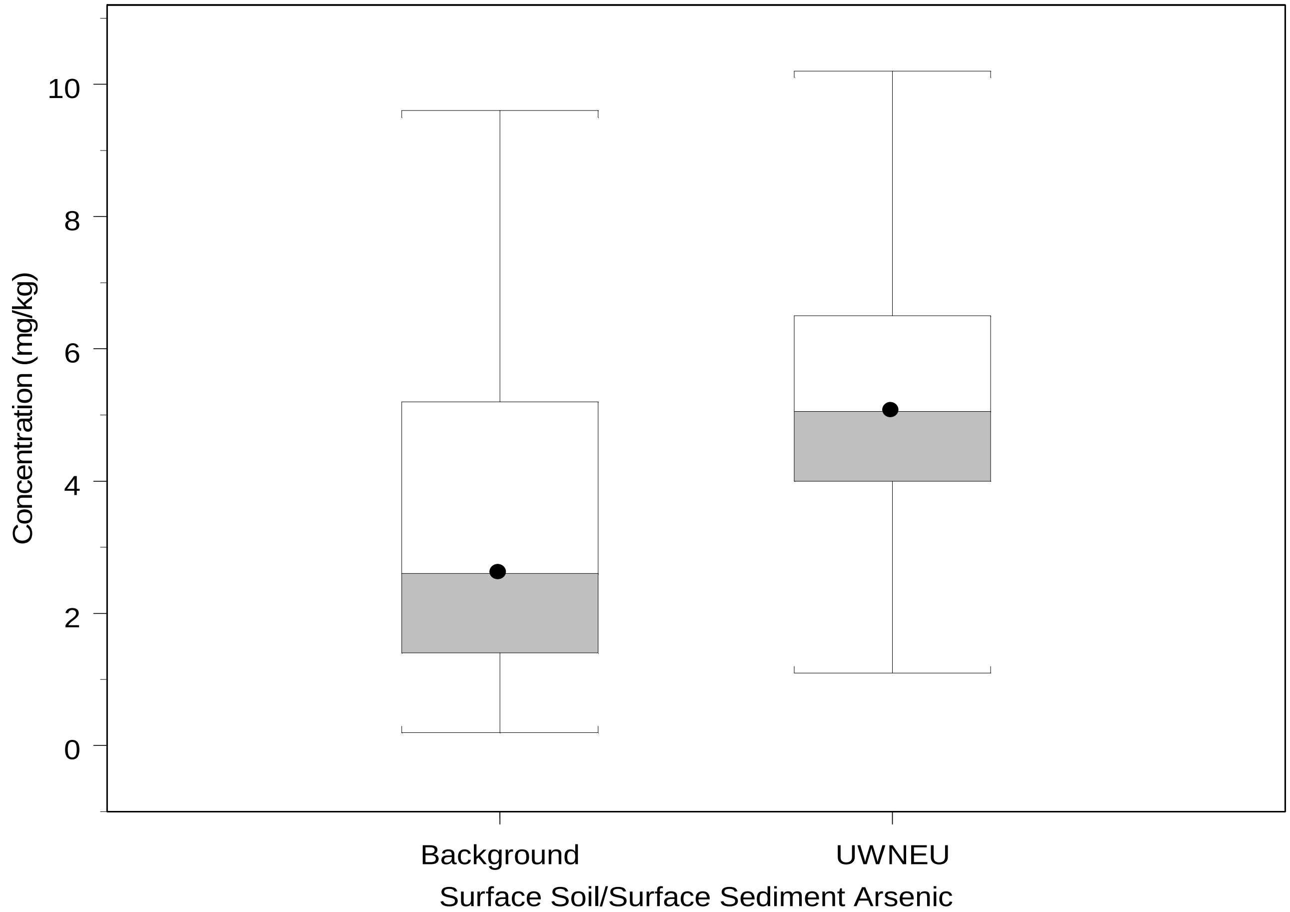
FIGURES

Figure A3.2.1
UWNEU Surface Soil (Non-PMJM) Box Plots for Aluminum



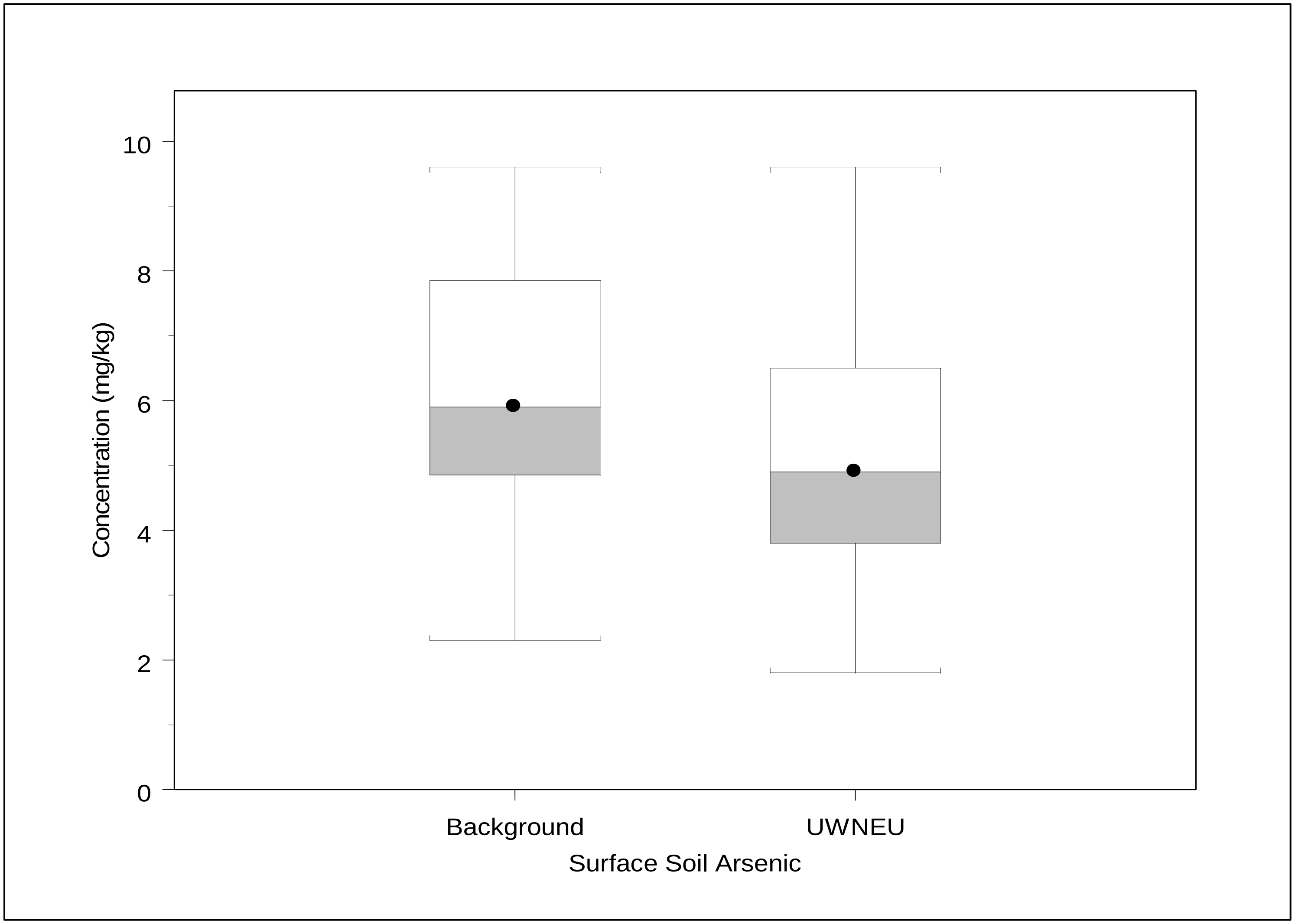
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.2
UWNEU Surface Soil/Surface Sediment Box Plots for Arsenic



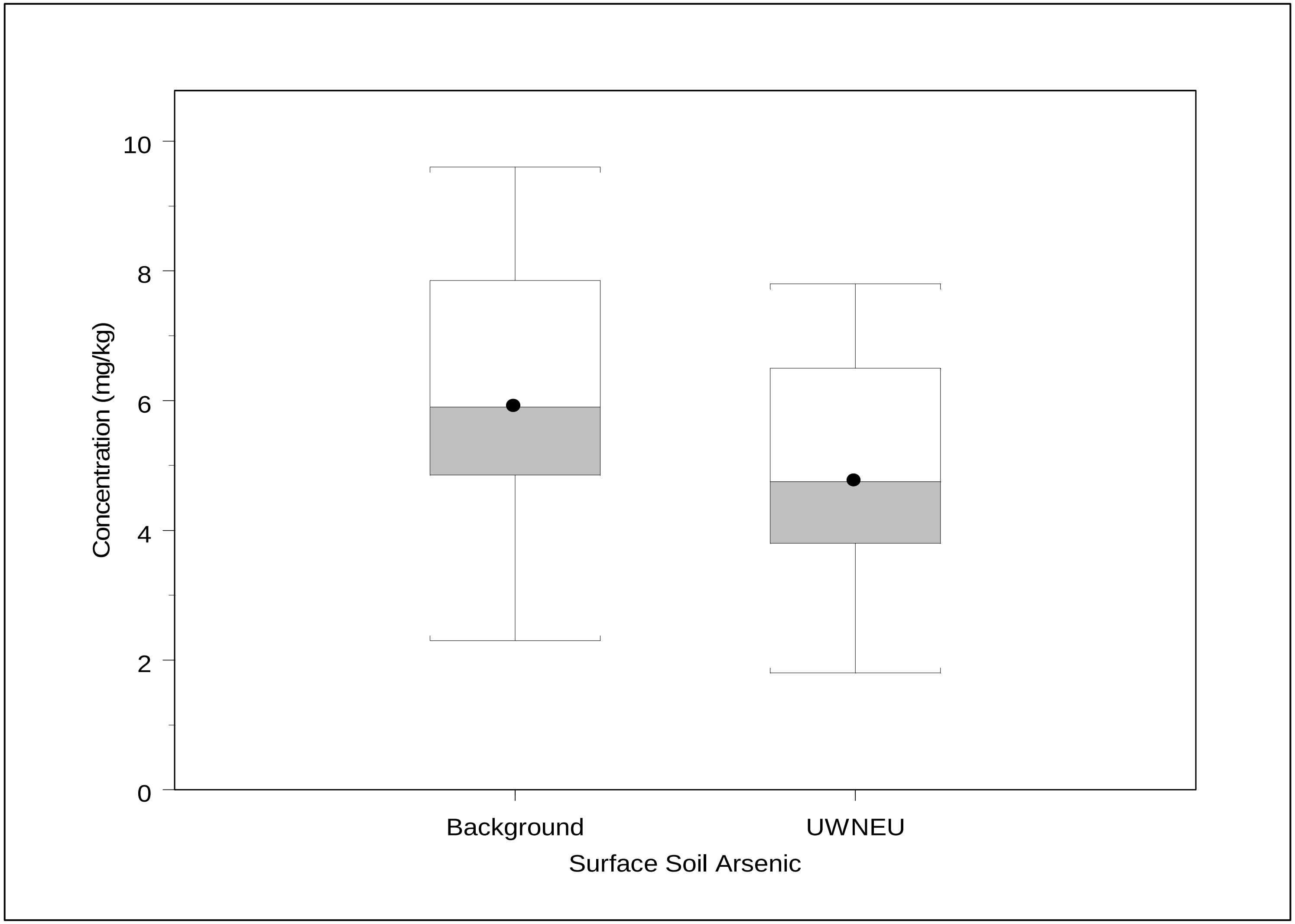
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.3
UWNEU Surface Soil (Non-PMJM) Box Plots for Arsenic



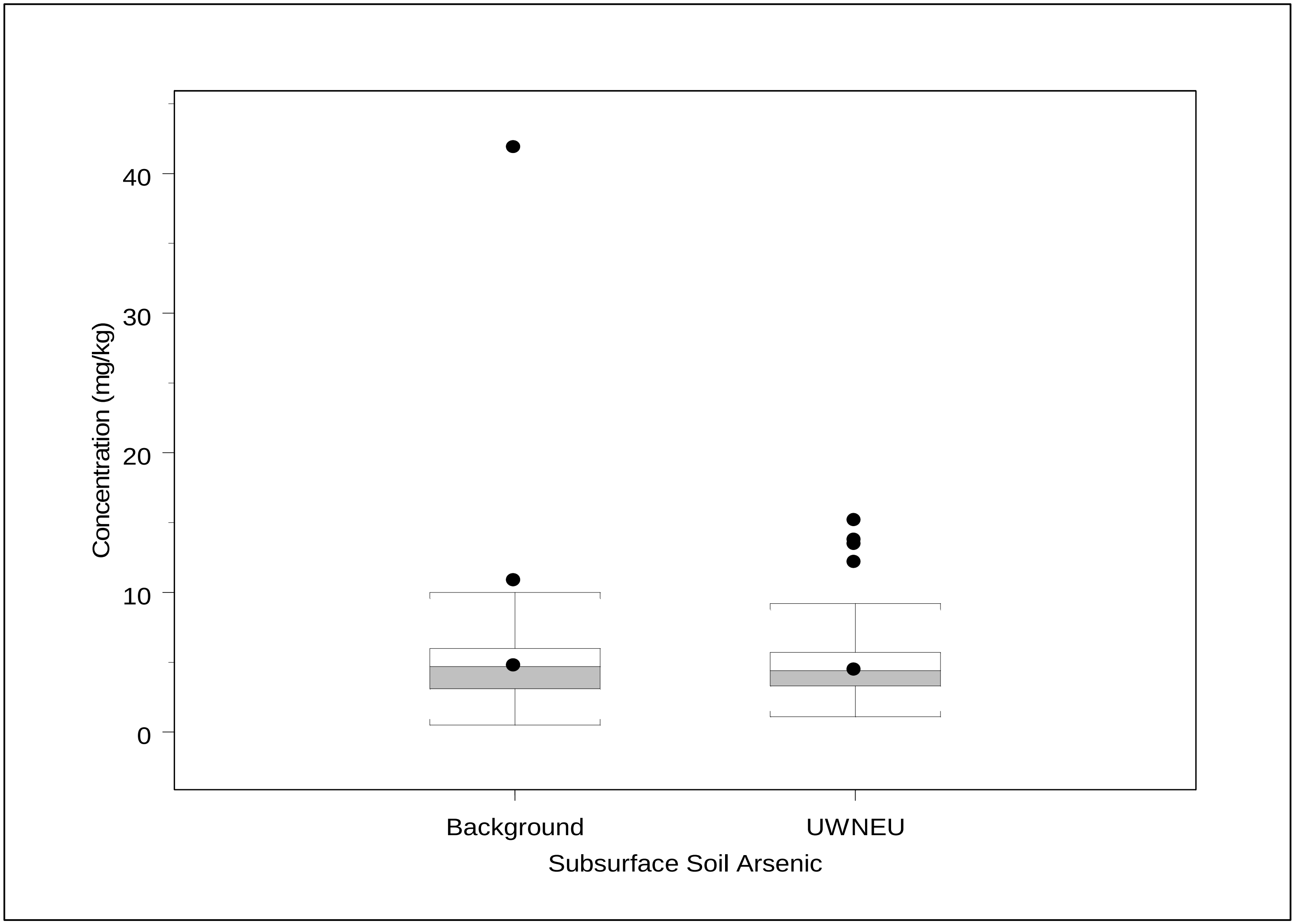
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.4
UWNEU Surface Soil (PMJM) Box Plots for Arsenic



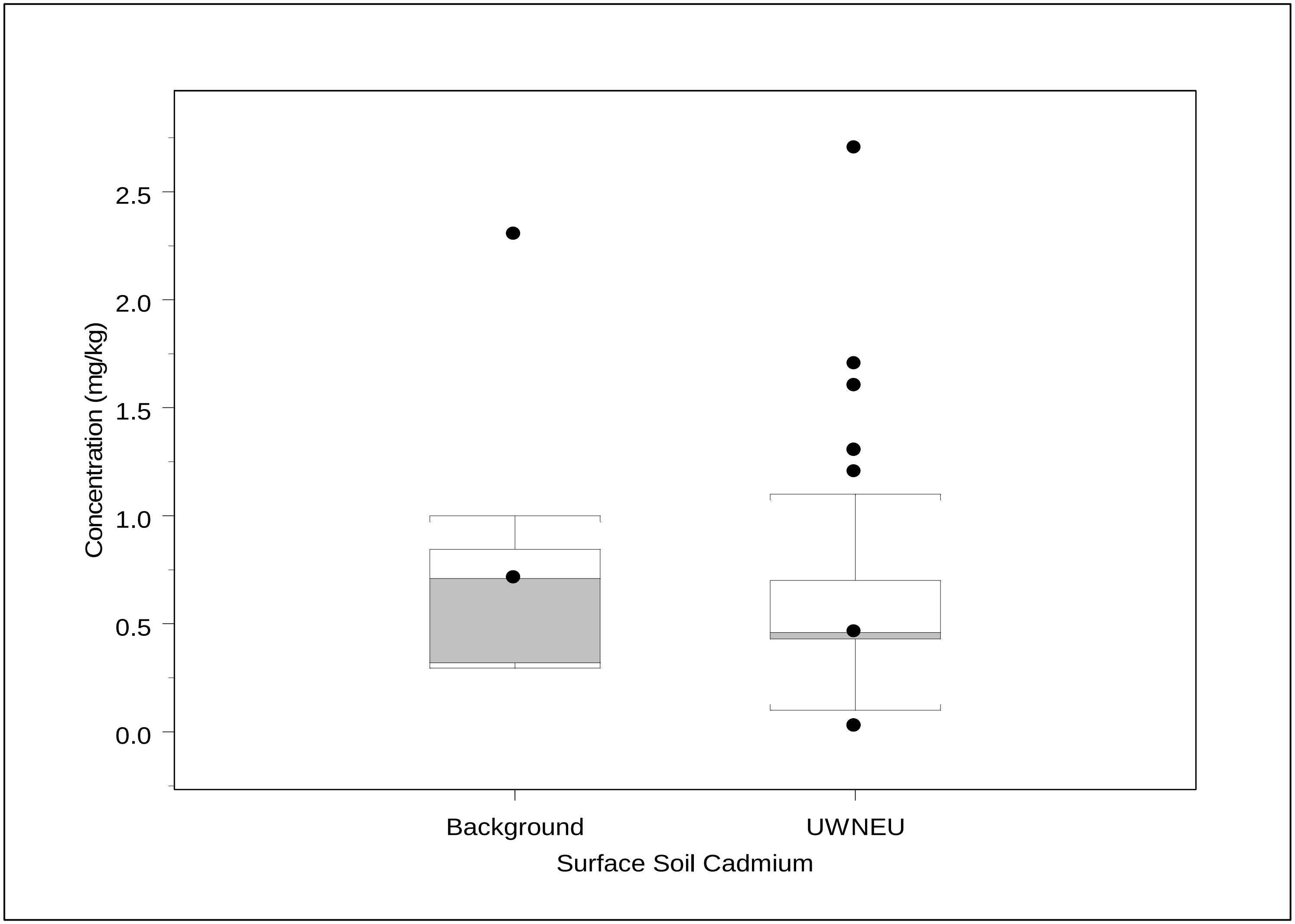
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.5
UWNEU Subsurface Soil Box Plots for Arsenic



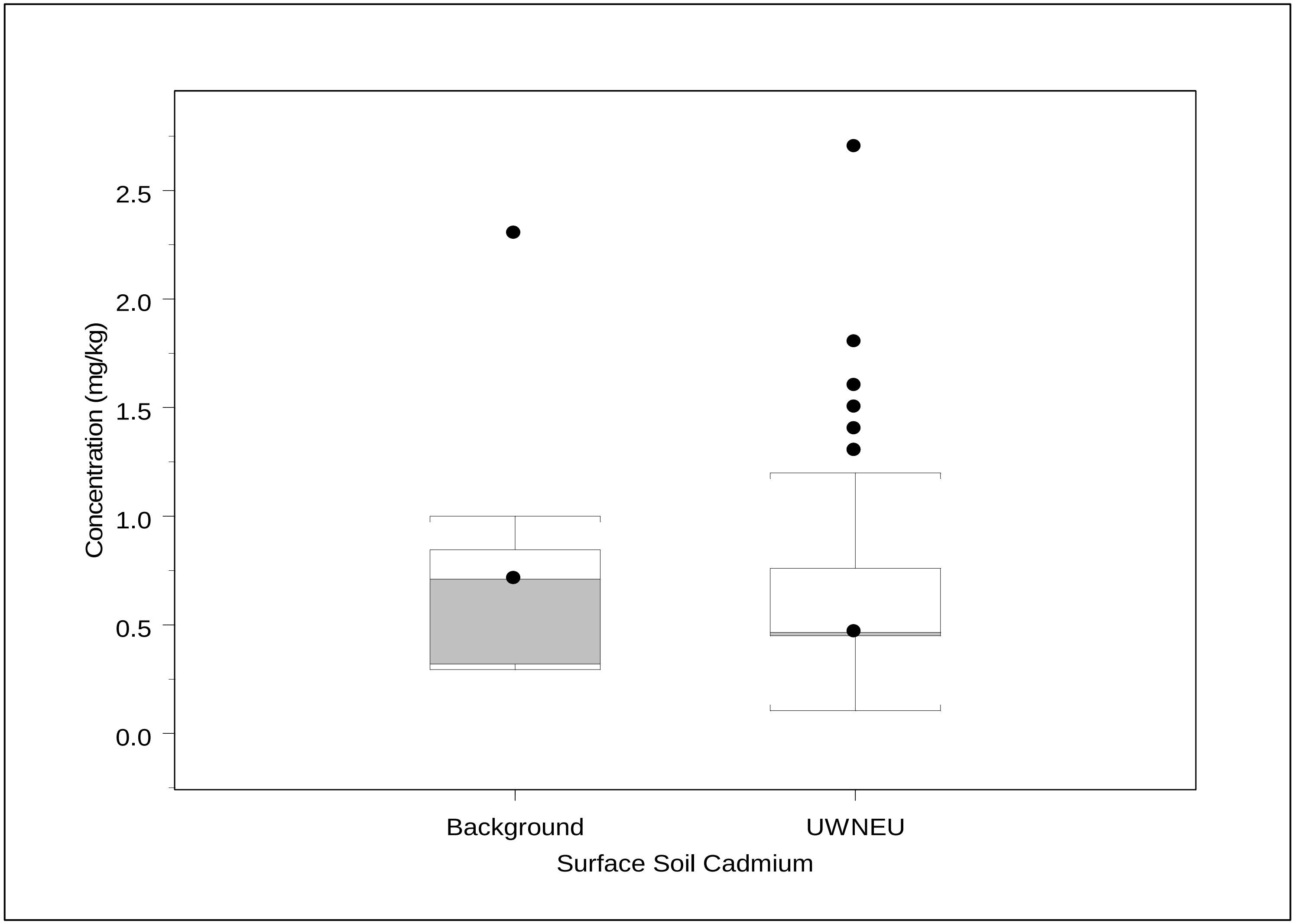
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.6
UWNEU Surface Soil (Non-PMJM) Box Plots for Cadmium



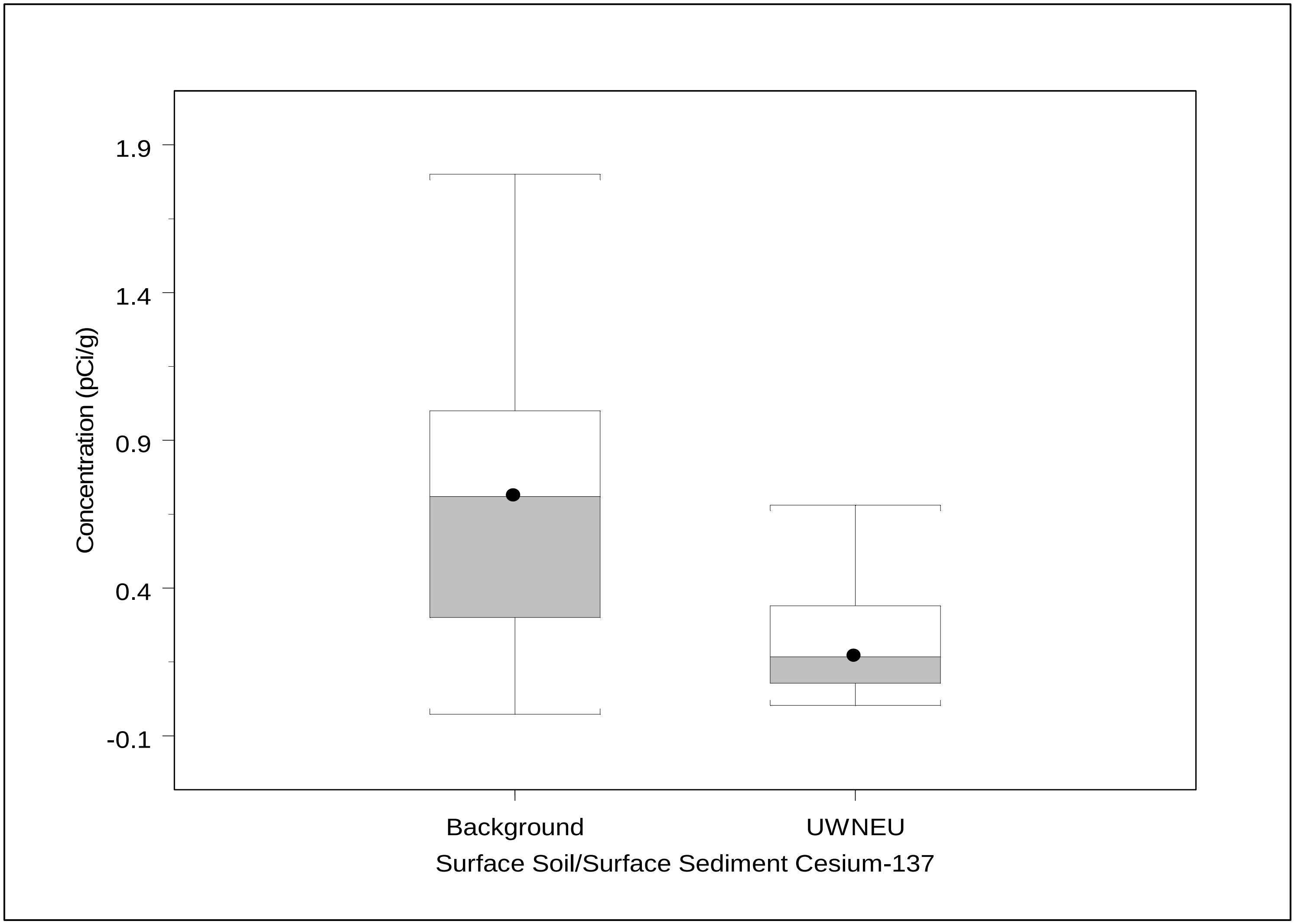
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.7
UWNEU Surface Soil (PMJM) Box Plots for Cadmium



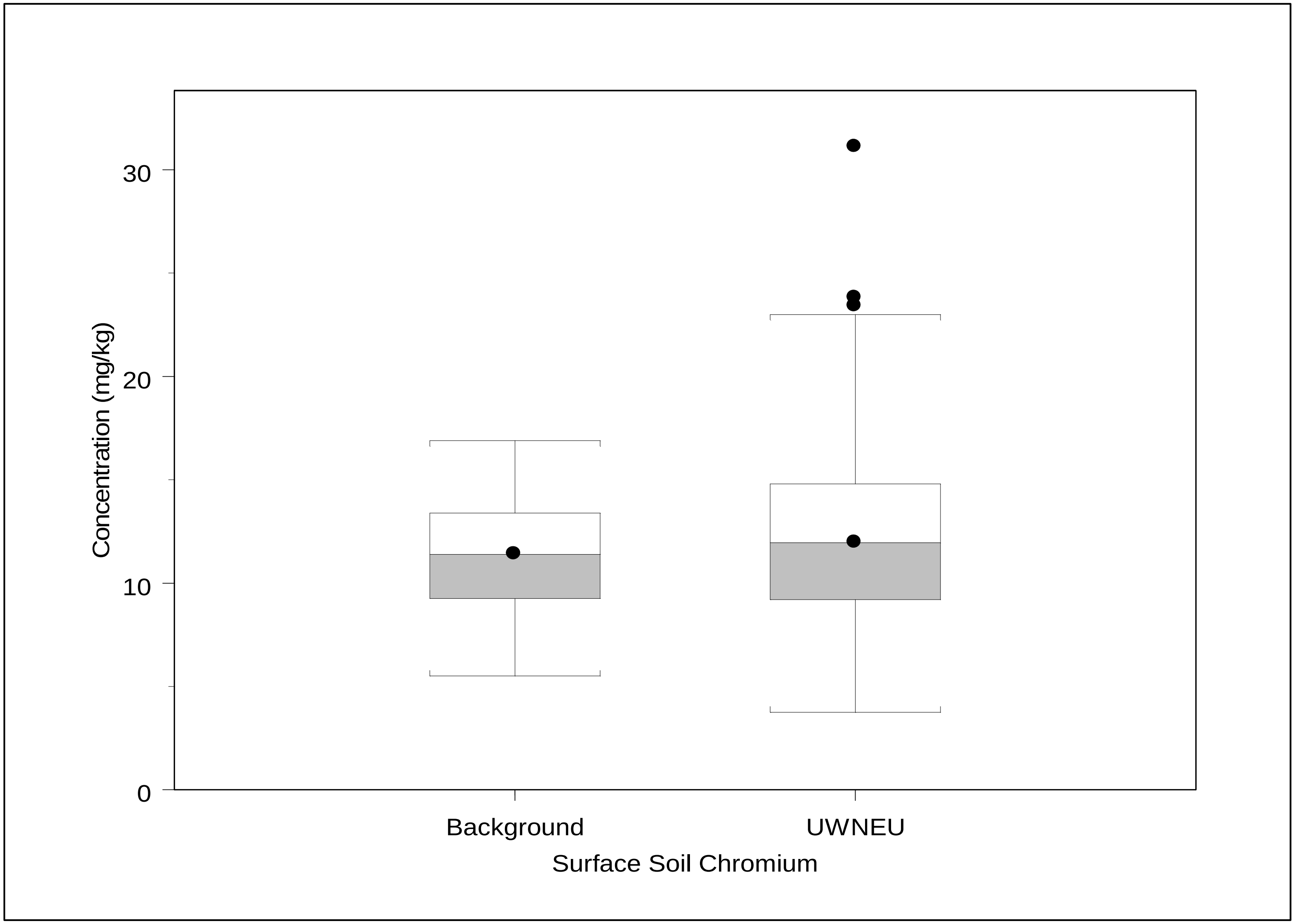
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.8
UWNEU Surface Soil/Surface Sediment Box Plots for Cesium-137



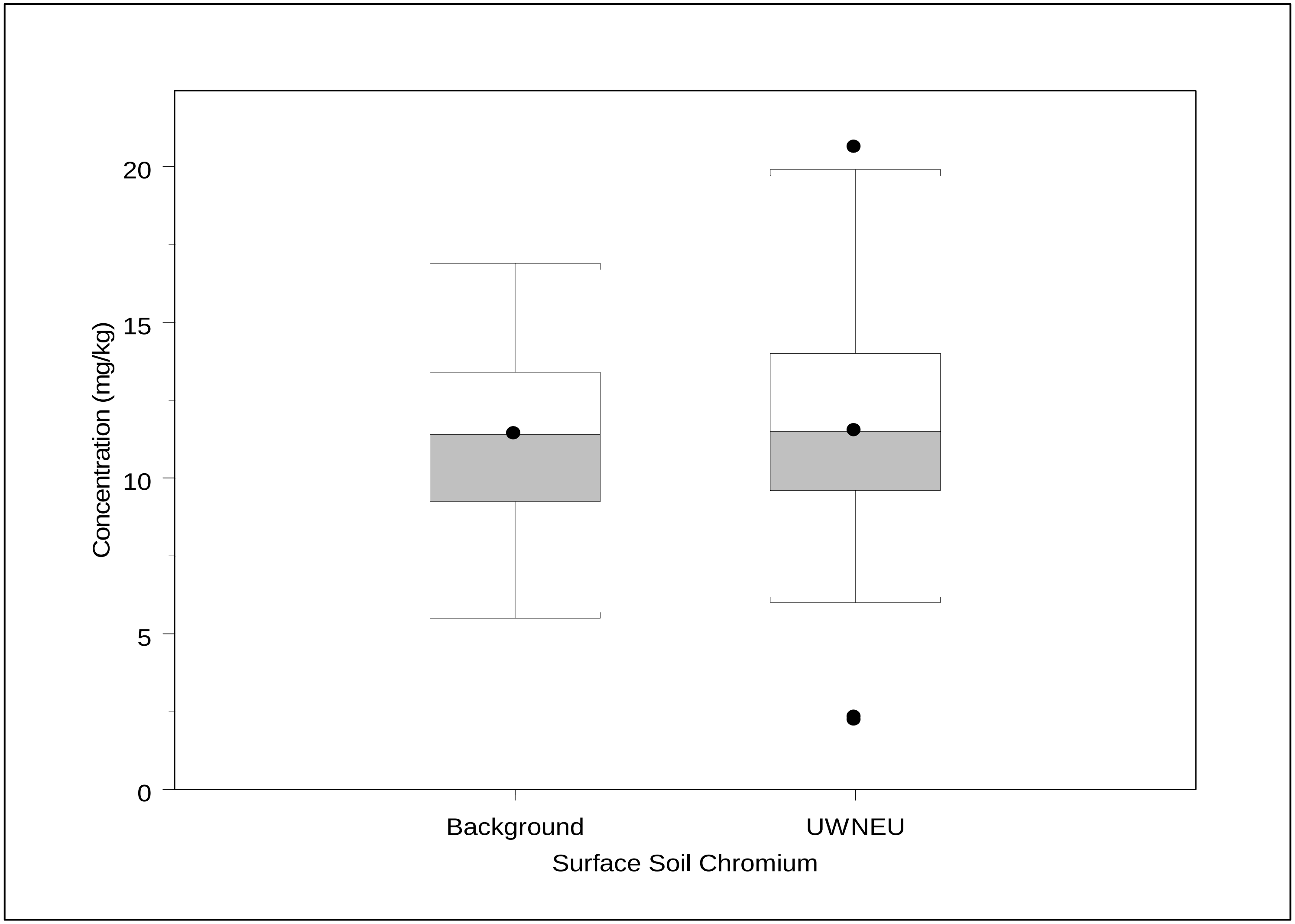
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.9
UWNEU Surface Soil (Non-PMJM) Box Plots for Chromium



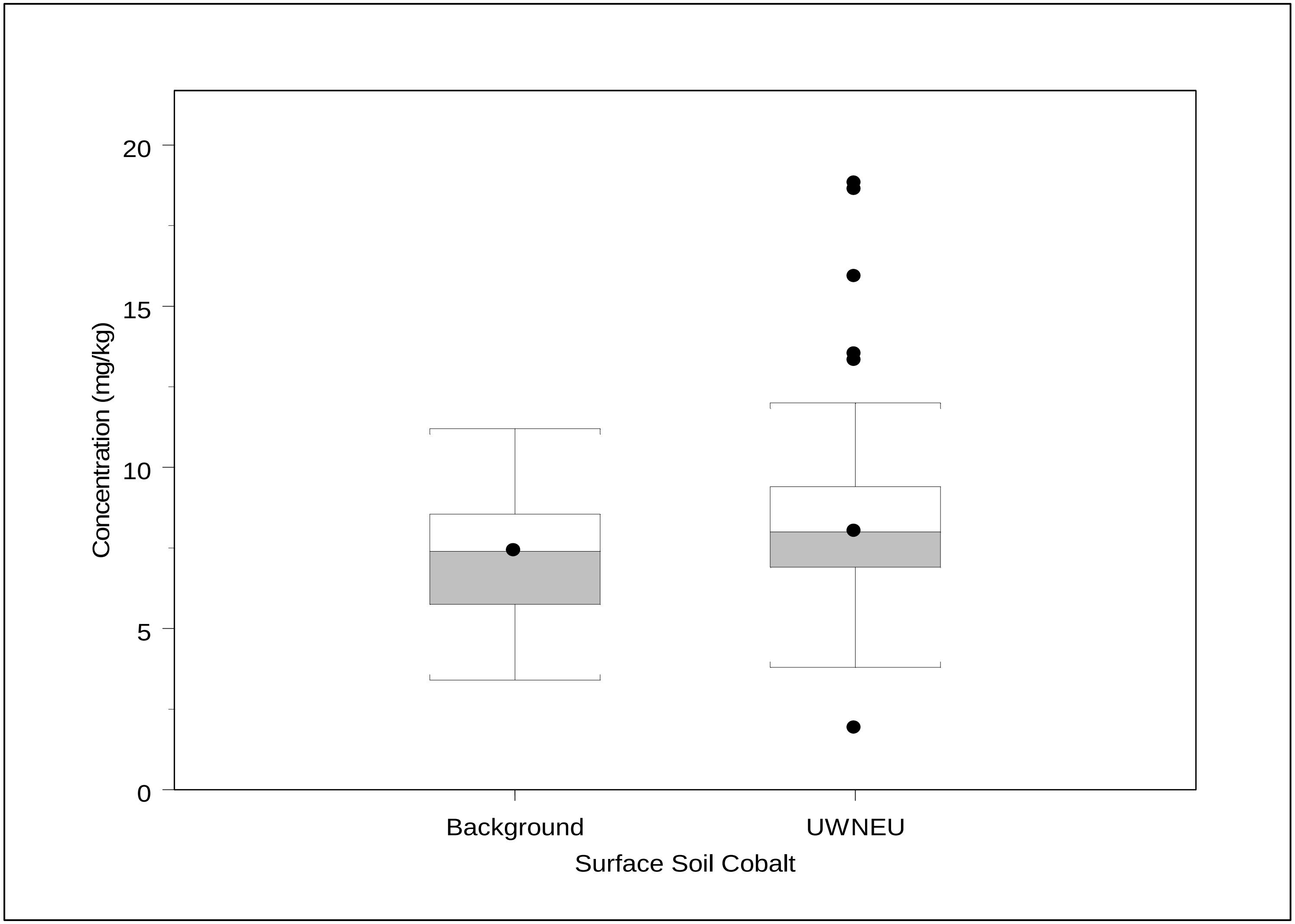
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.10
UWNEU Surface Soil (PMJM) Box Plots for Chromium



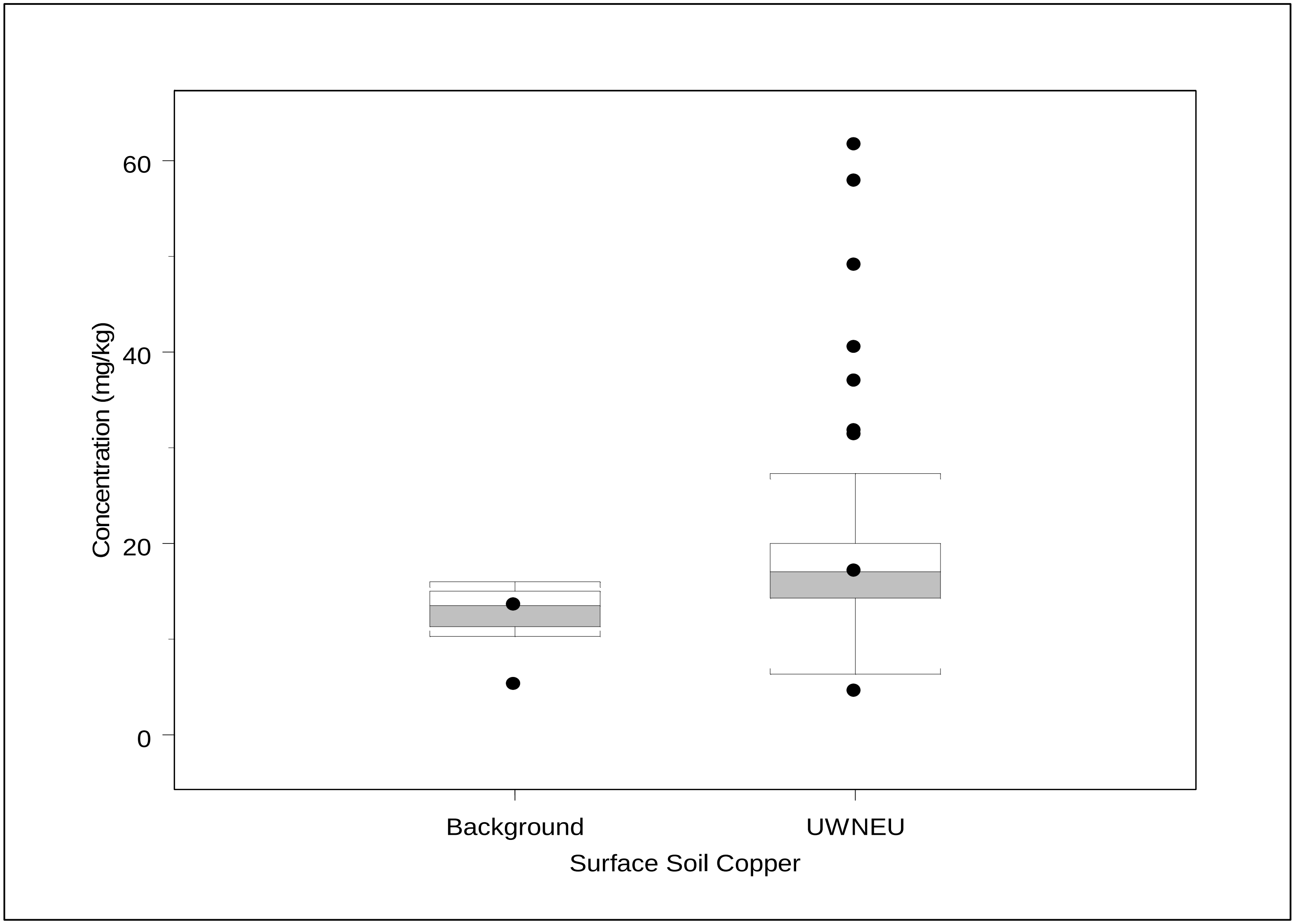
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.11
UWNEU Surface Soil (Non-PMJM) Box Plots for Cobalt



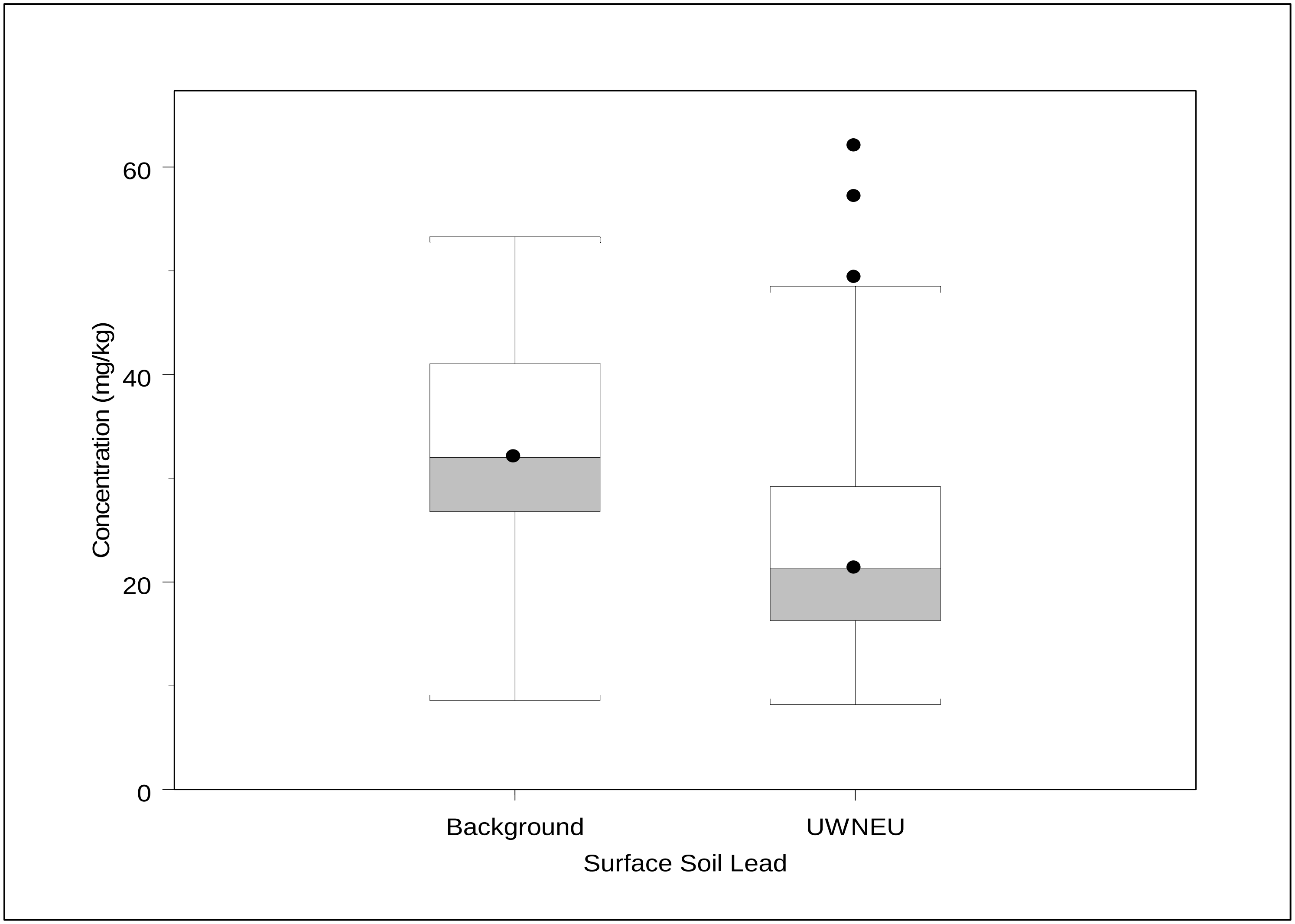
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.12
UWNEU Surface Soil (Non-PMJM) Box Plots for Copper



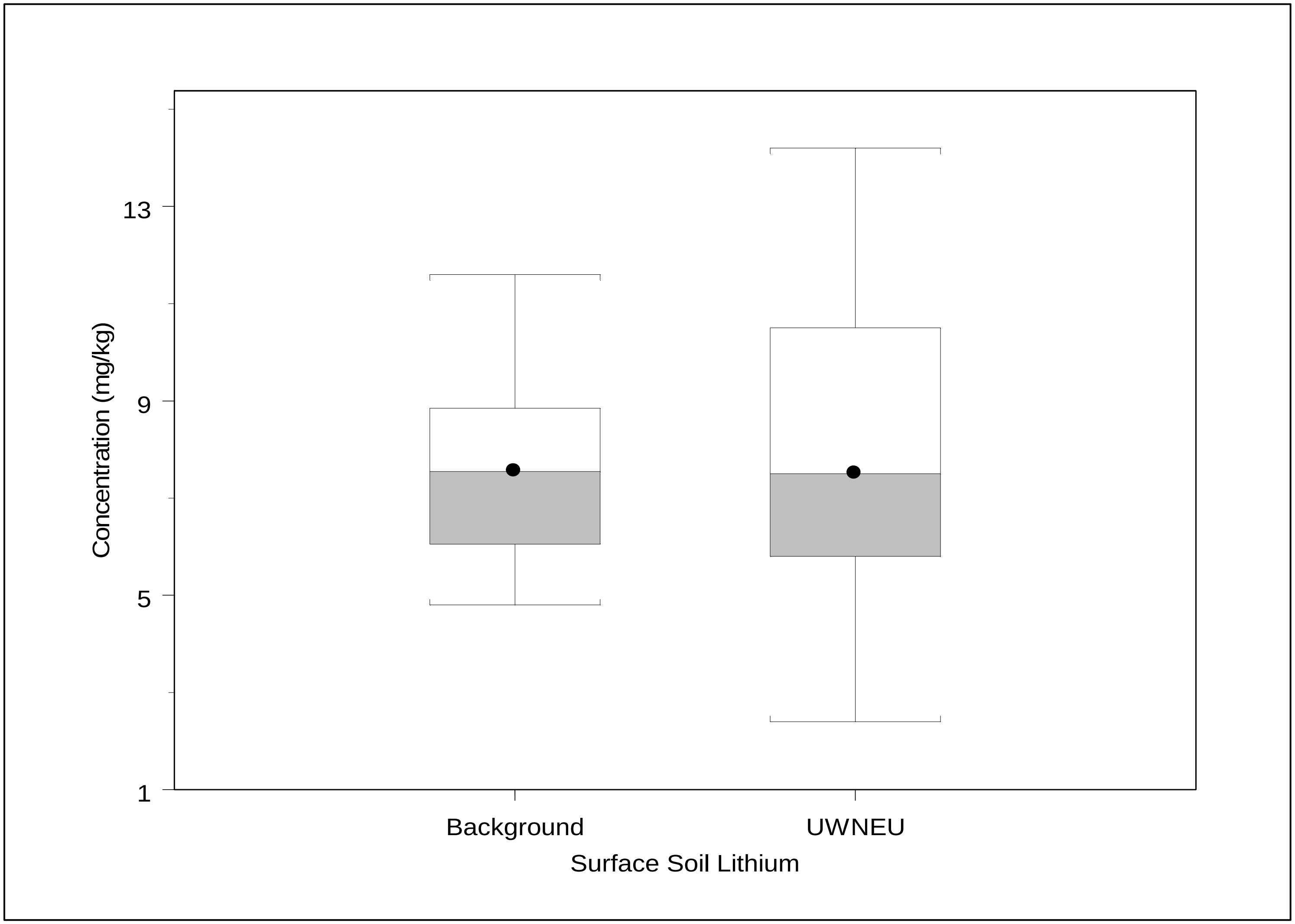
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.13
UWNEU Surface Soil (Non-PMJM) Box Plots for Lead



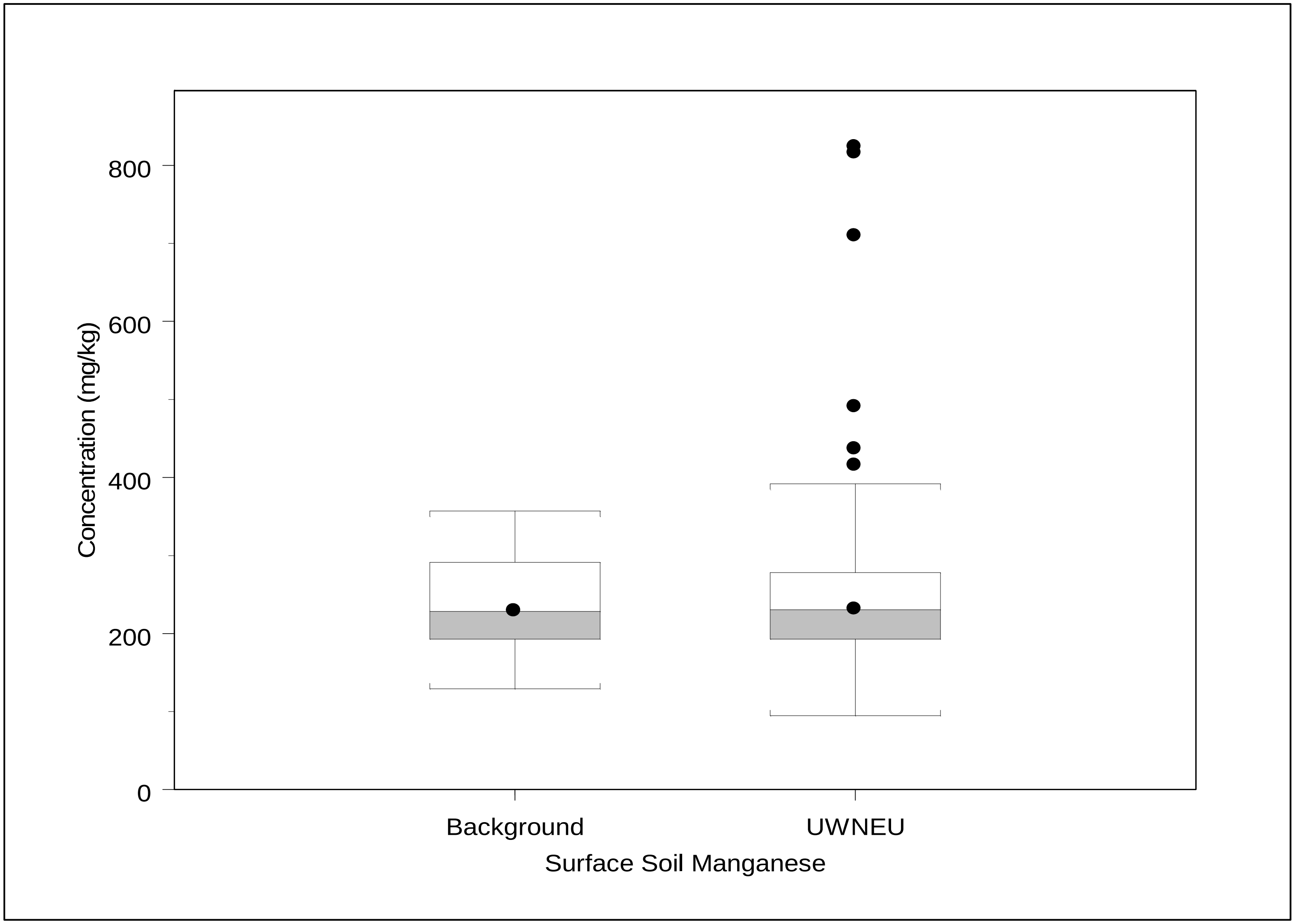
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.14
UWNEU Surface Soil (Non-PMJM) Box Plots for Lithium



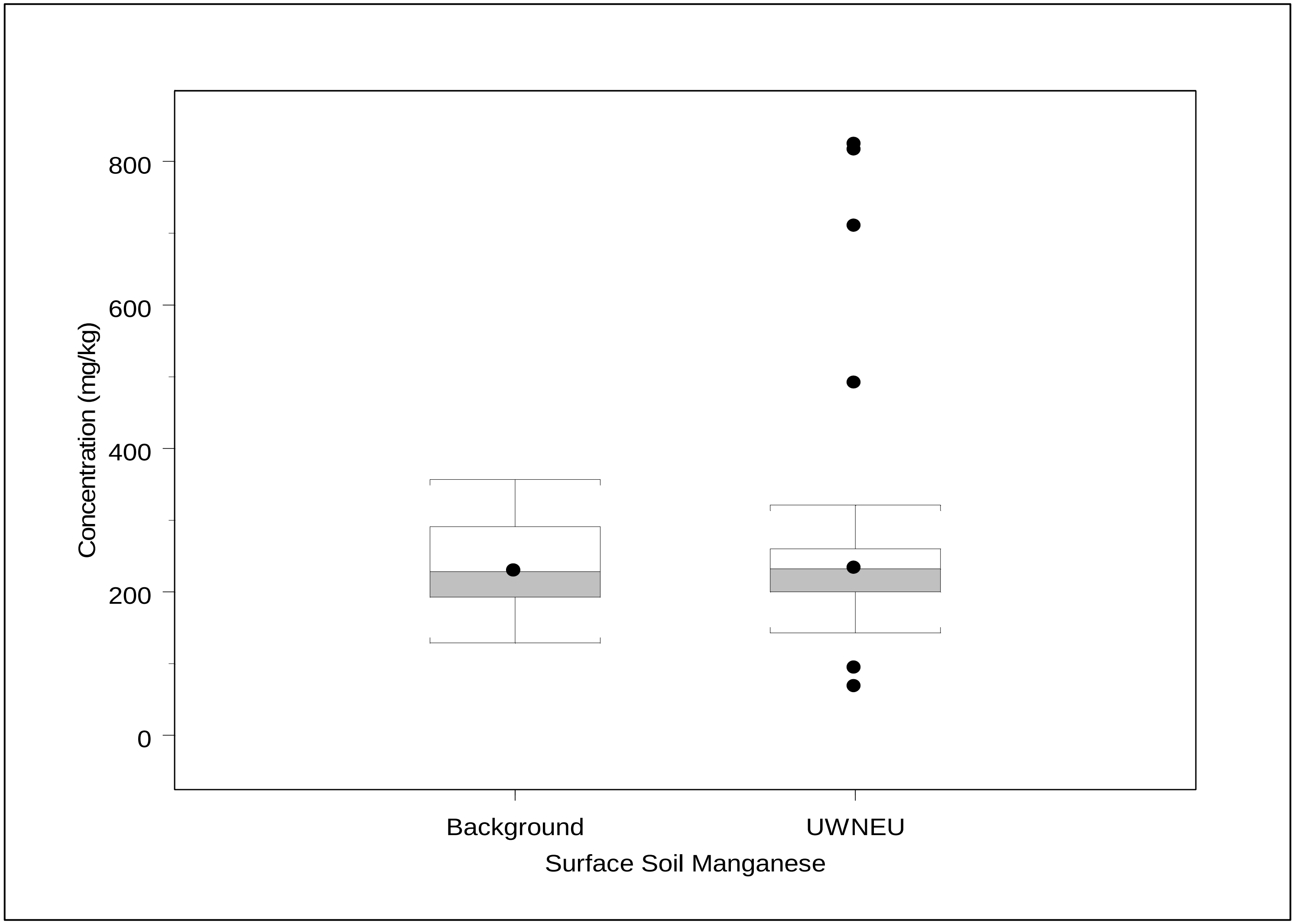
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.15
UWNEU Surface Soil (Non-PMJM) Box Plots for Manganese



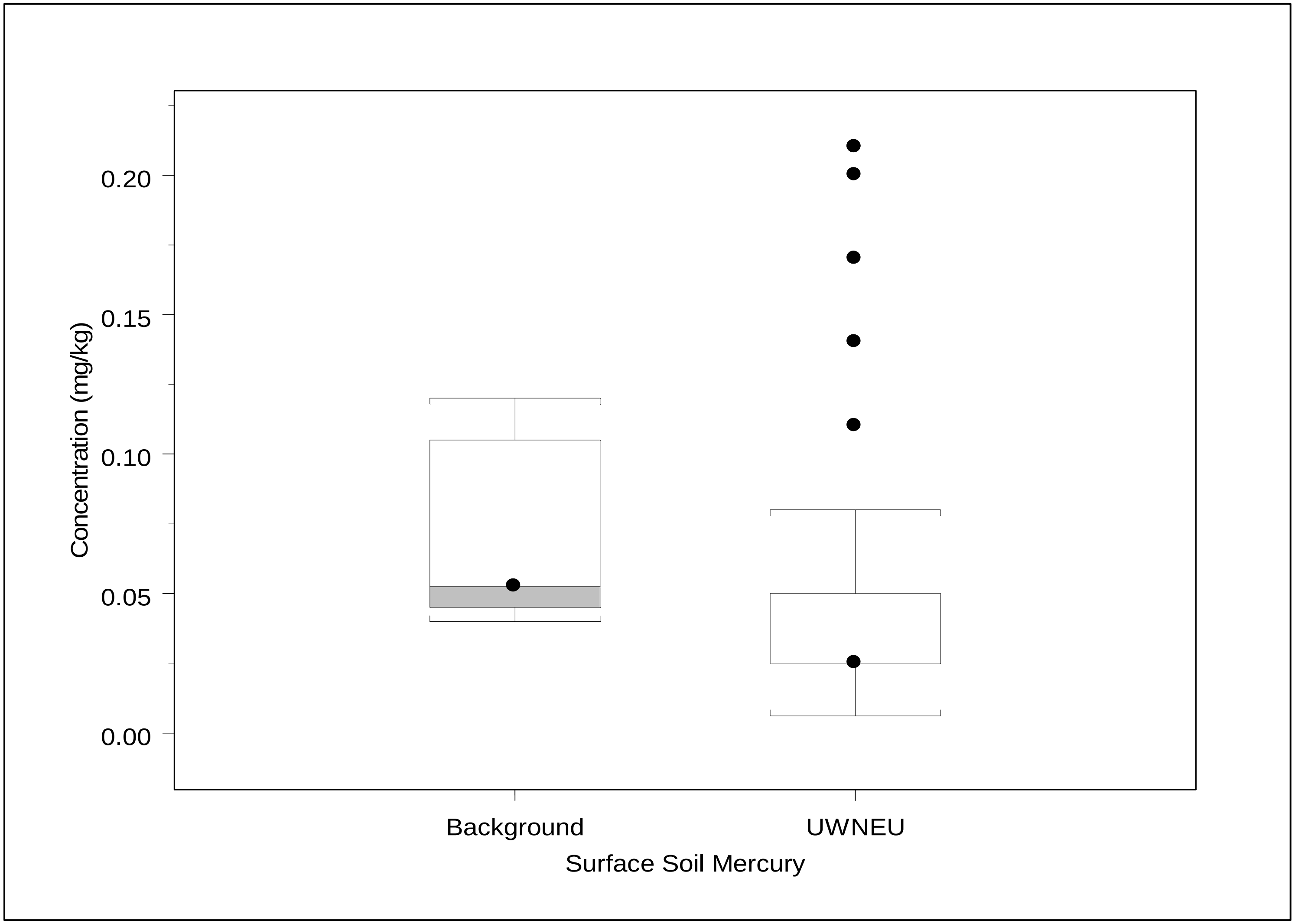
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.16
UWNEU Surface Soil (PMJM) Box Plots for Manganese



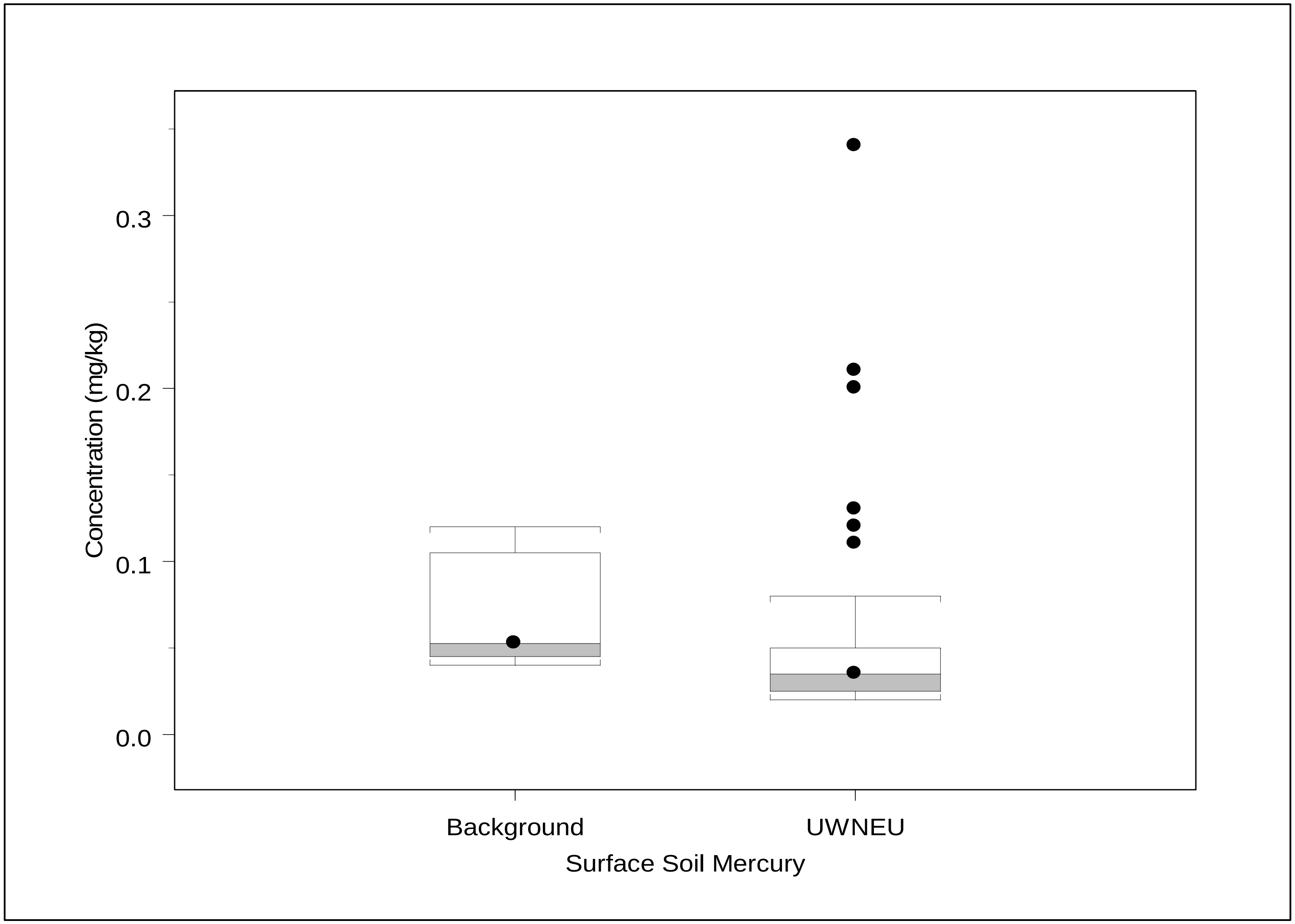
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.17
UWNEU Surface Soil (Non-PMJM) Box Plots for Mercury



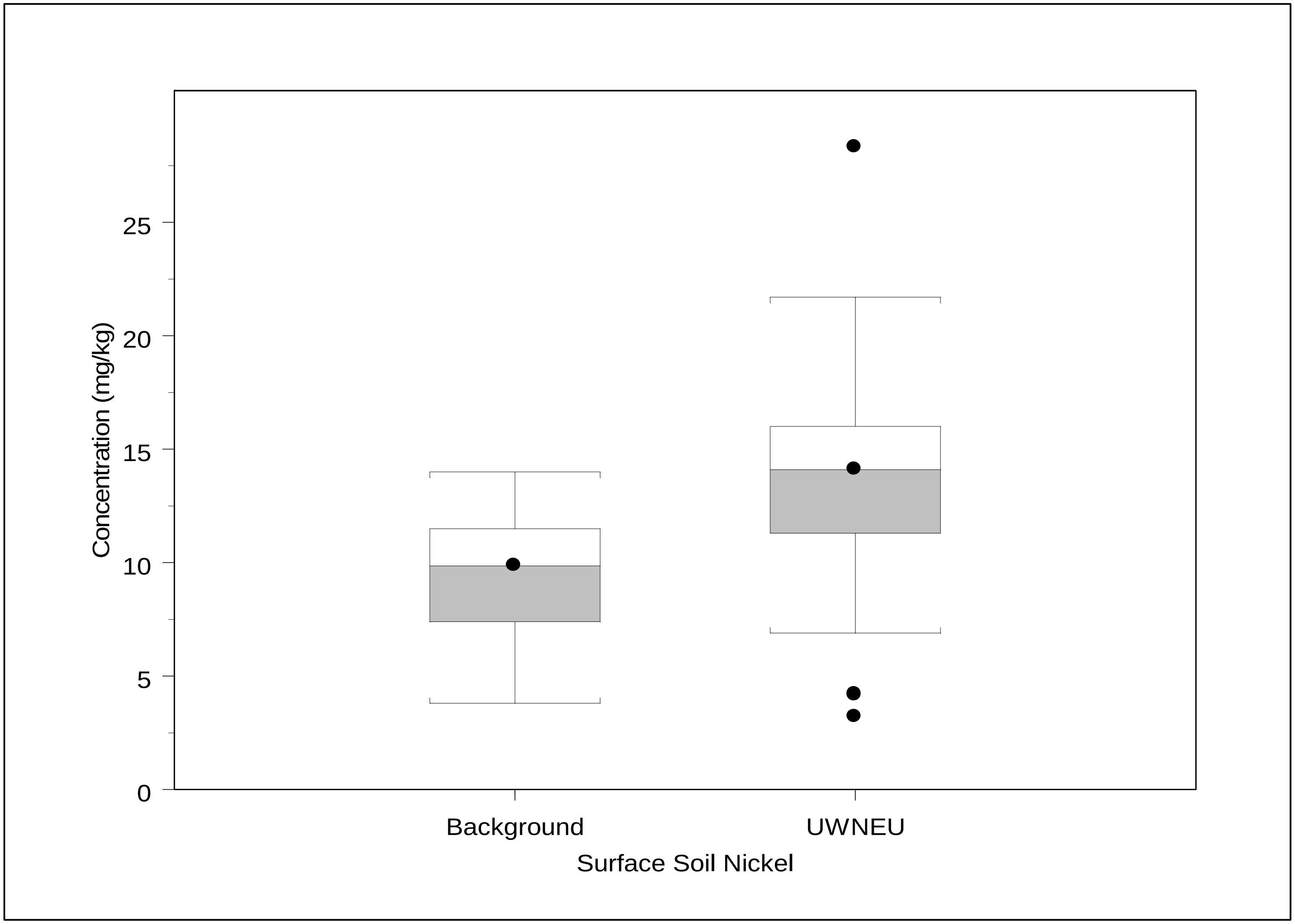
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.18
UWNEU Surface Soil (PMJM) Box Plots for Mercury



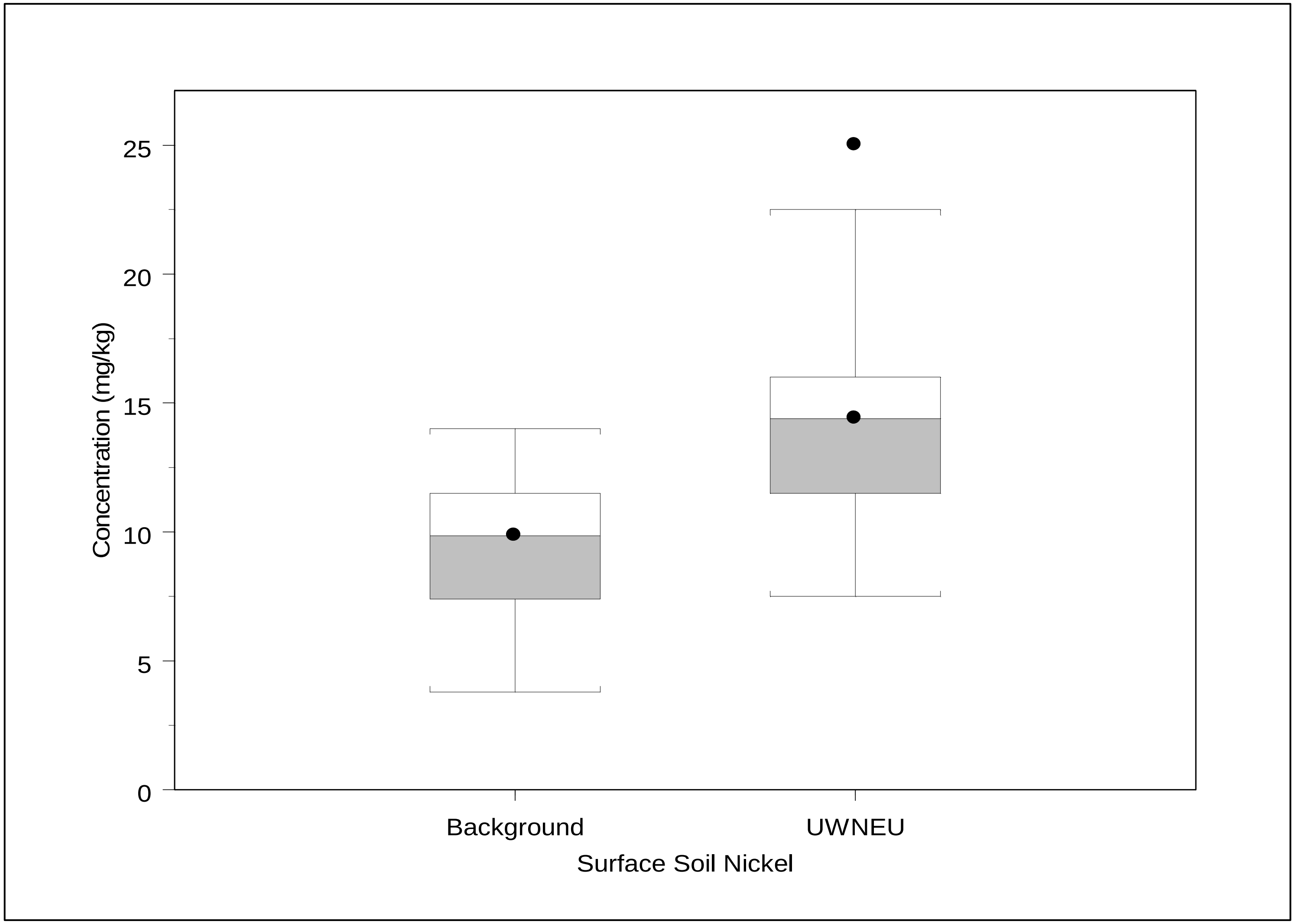
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.19
UWNEU Surface Soil (Non-PMJM) Box Plots for Nickel



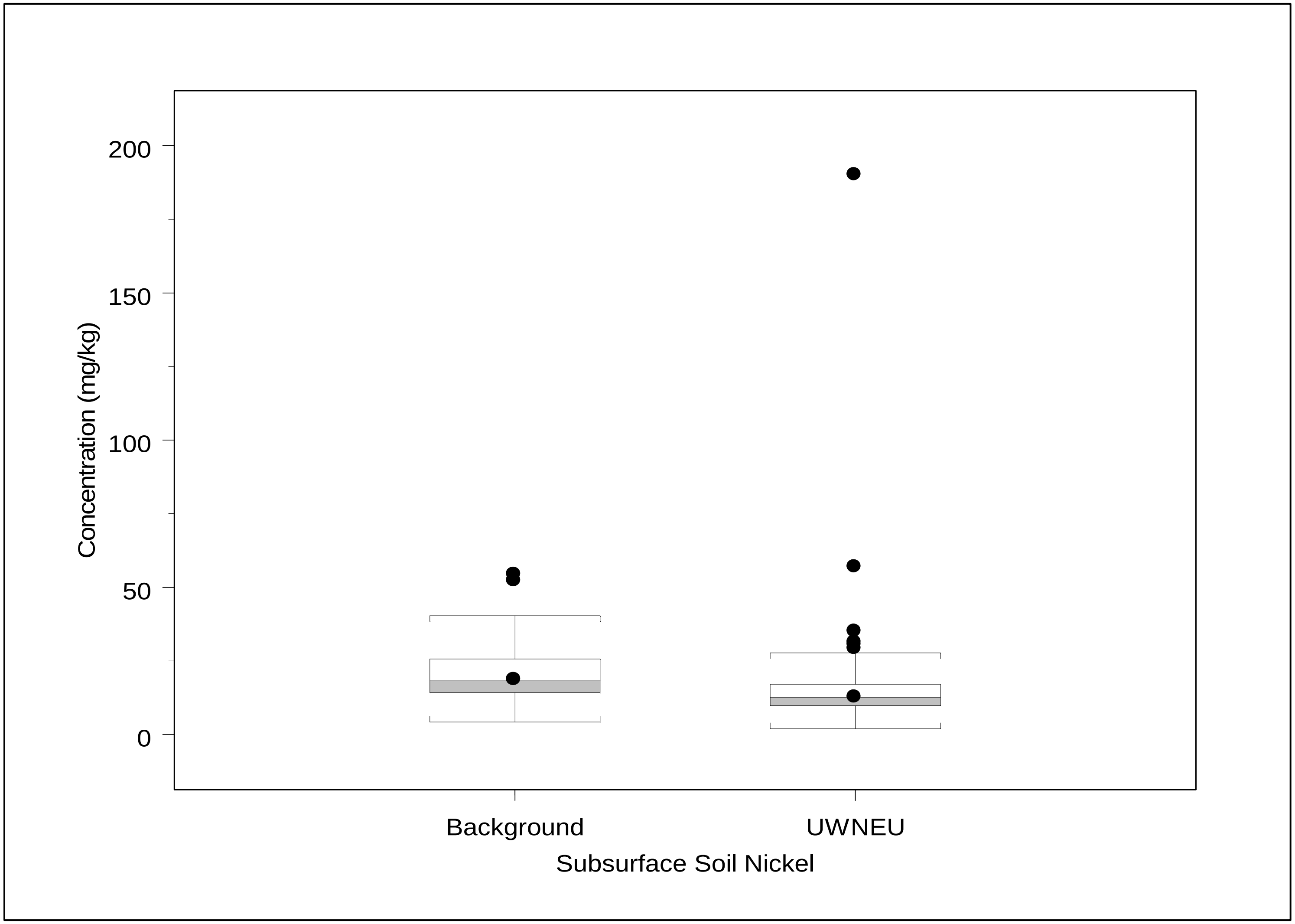
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.20
UWNEU Surface Soil (PMJM) Box Plots for Nickel



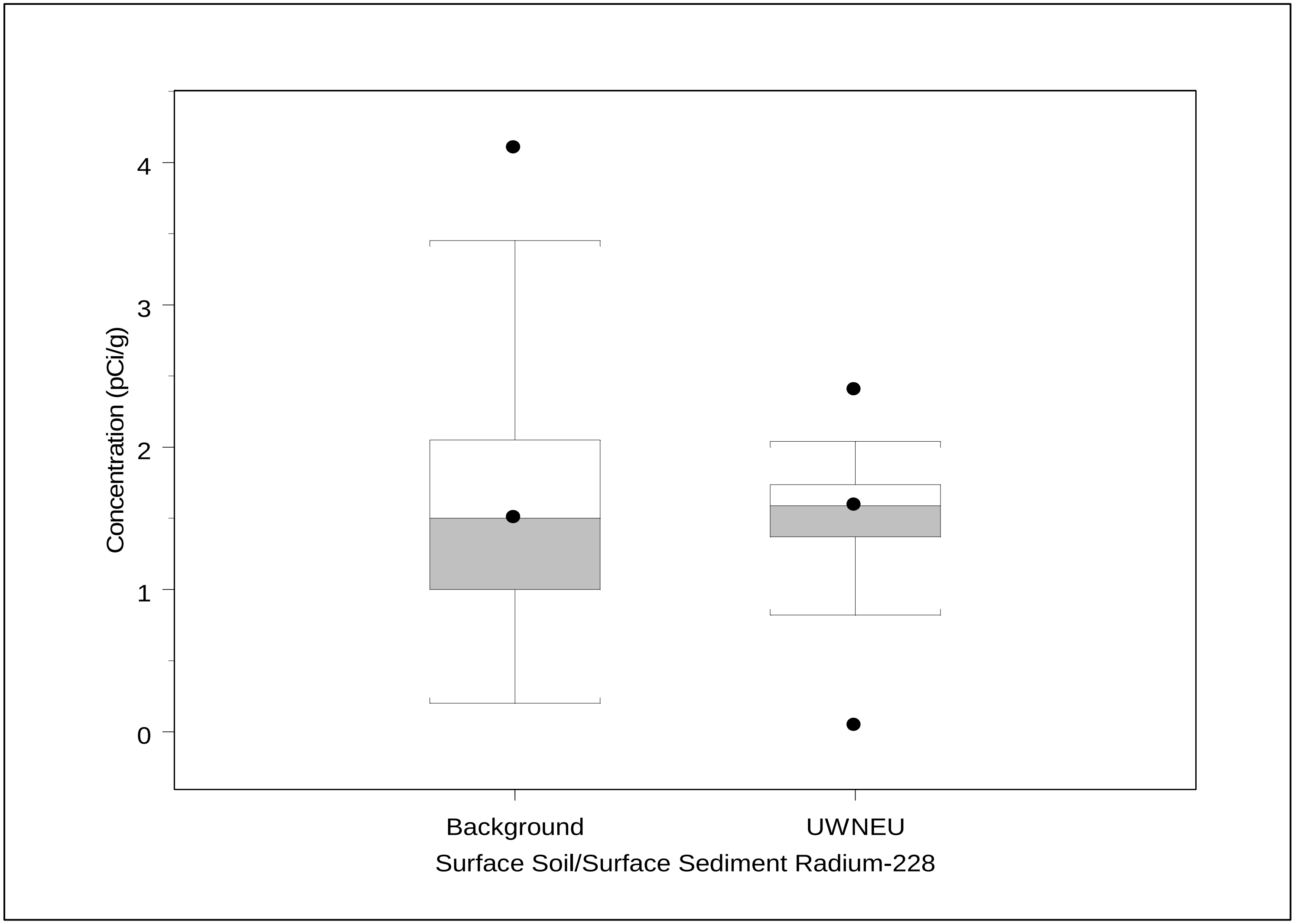
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.21
UWNEU Subsurface Soil Box Plots for Nickel



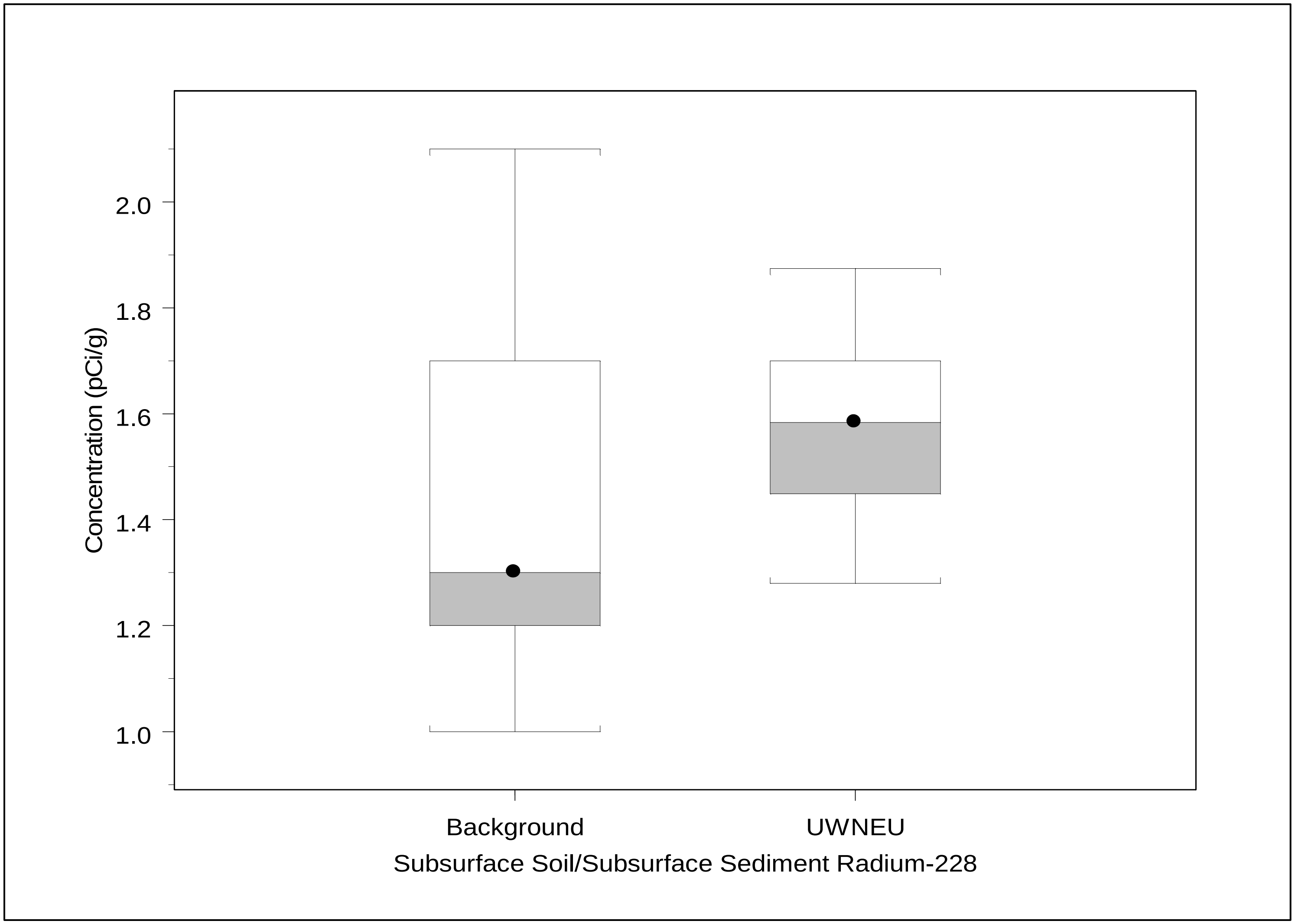
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.22
UWNEU Surface Soil/Surface Sediment Box Plots for Radium-228



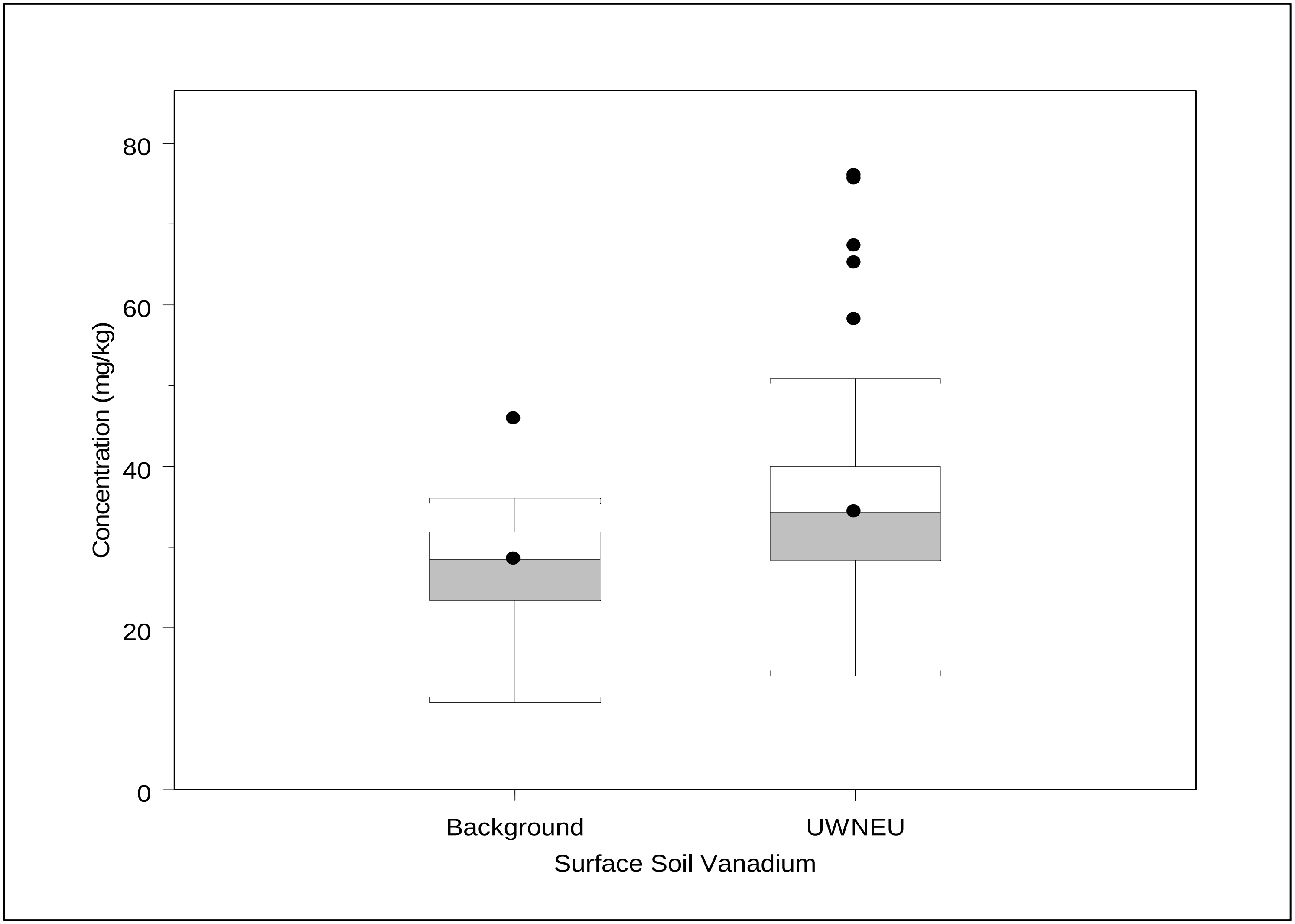
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.23
UWNEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-228



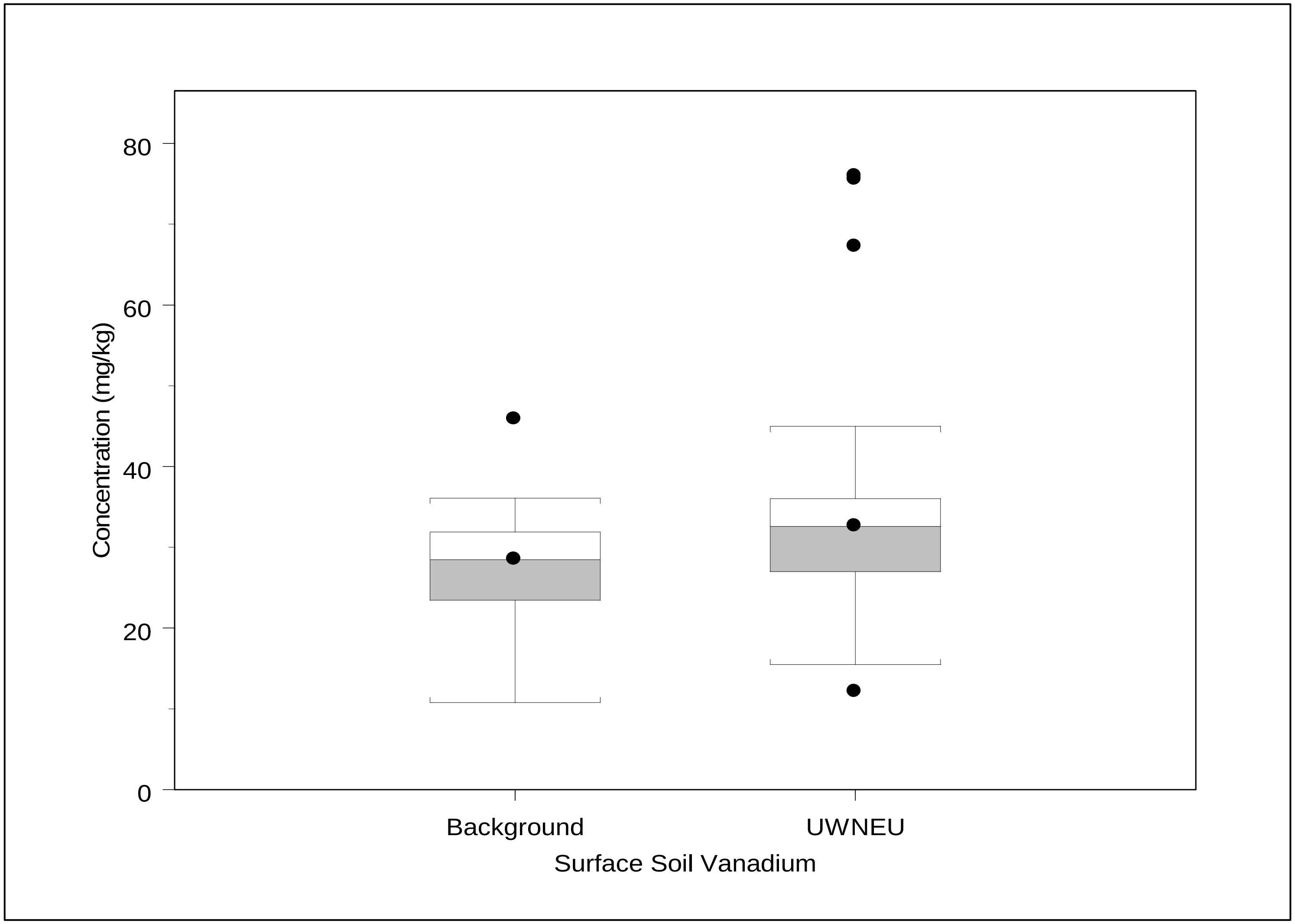
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.3.24
UWNEU Surface Soil (Non-PMJM) Box Plots for Vanadium



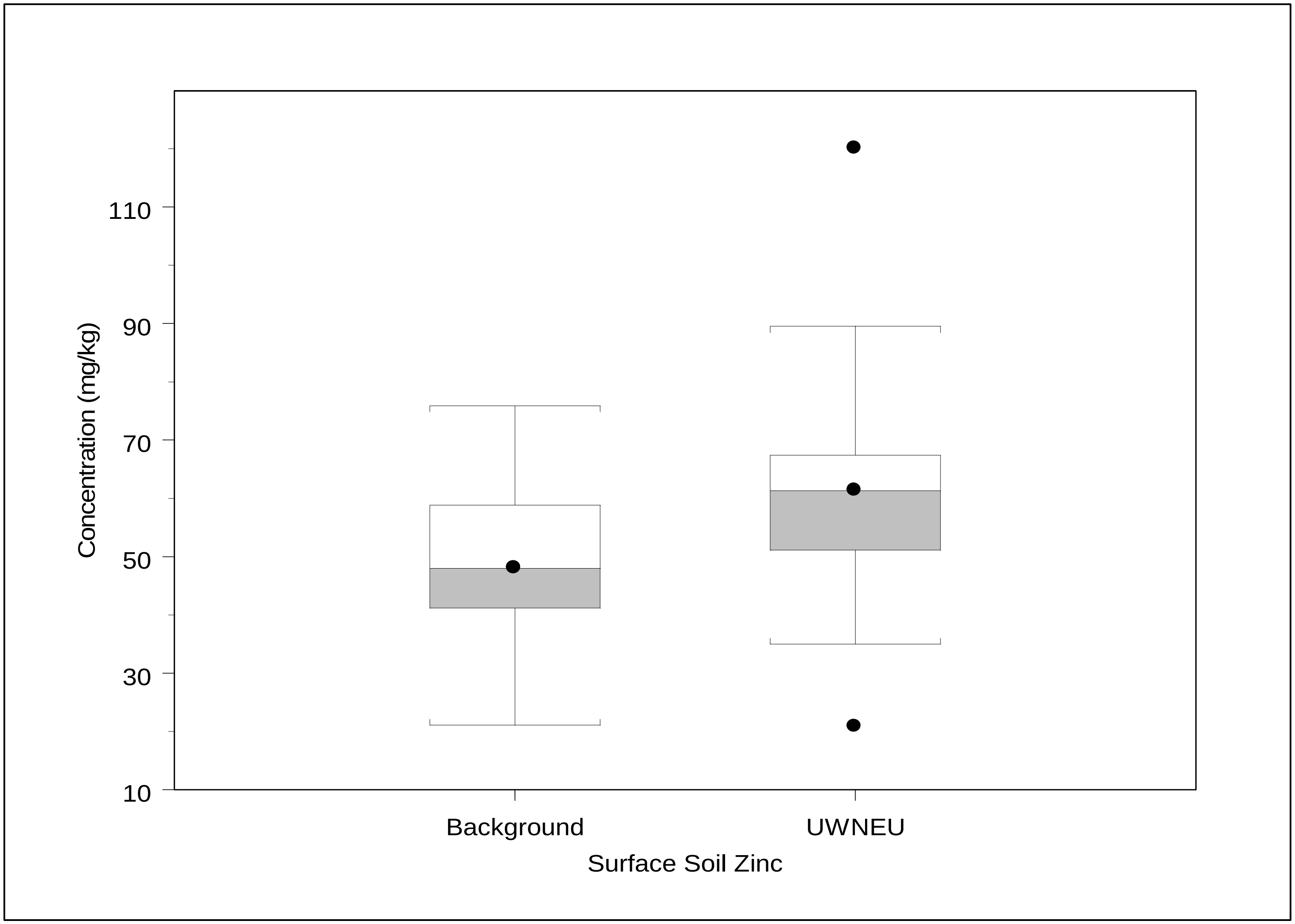
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.25
UWNEU Surface Soil (PMJM) Box Plots for Vanadium



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.26
UWNEU Surface Soil (Non-PMJM) Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

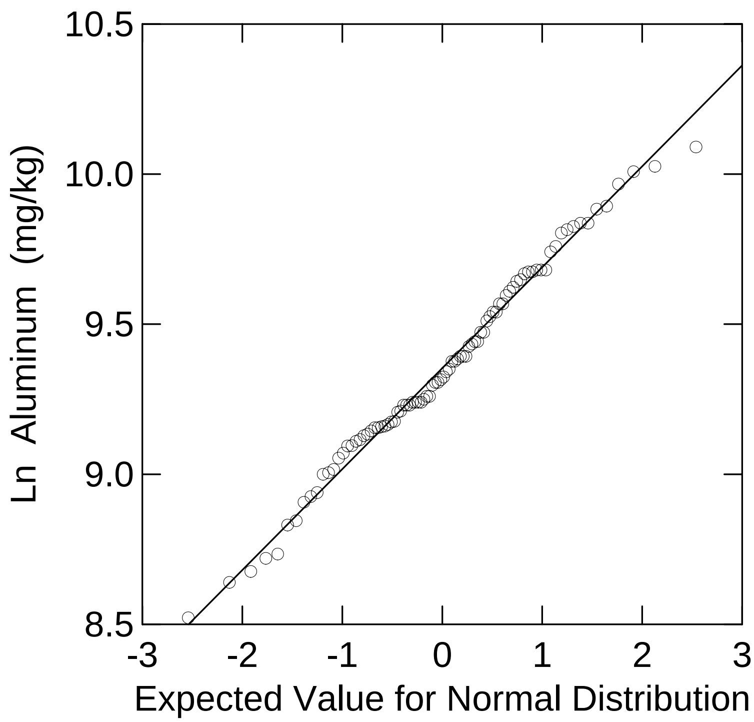


Figure A3.4.1 Probability Plot for Aluminum Concentrations (Natural Logarithm) in UWNEU Surface Soil

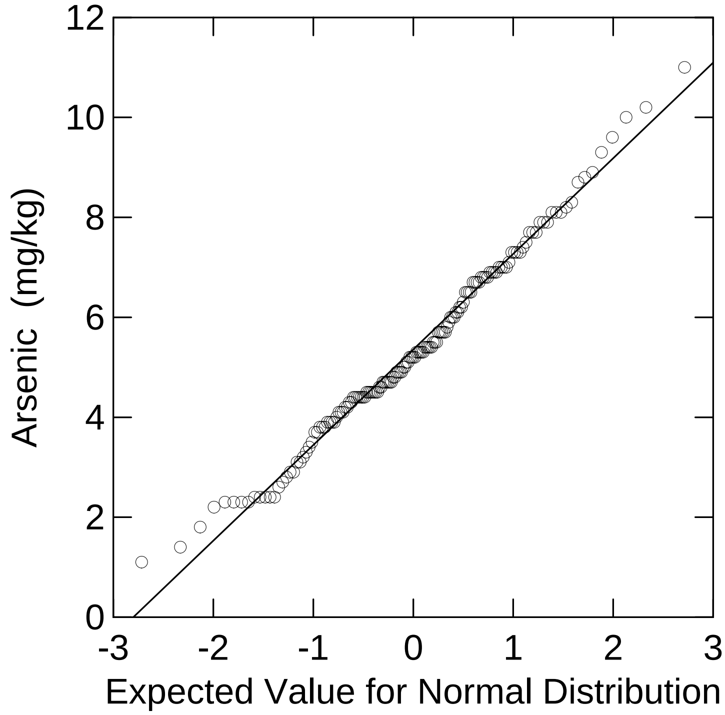
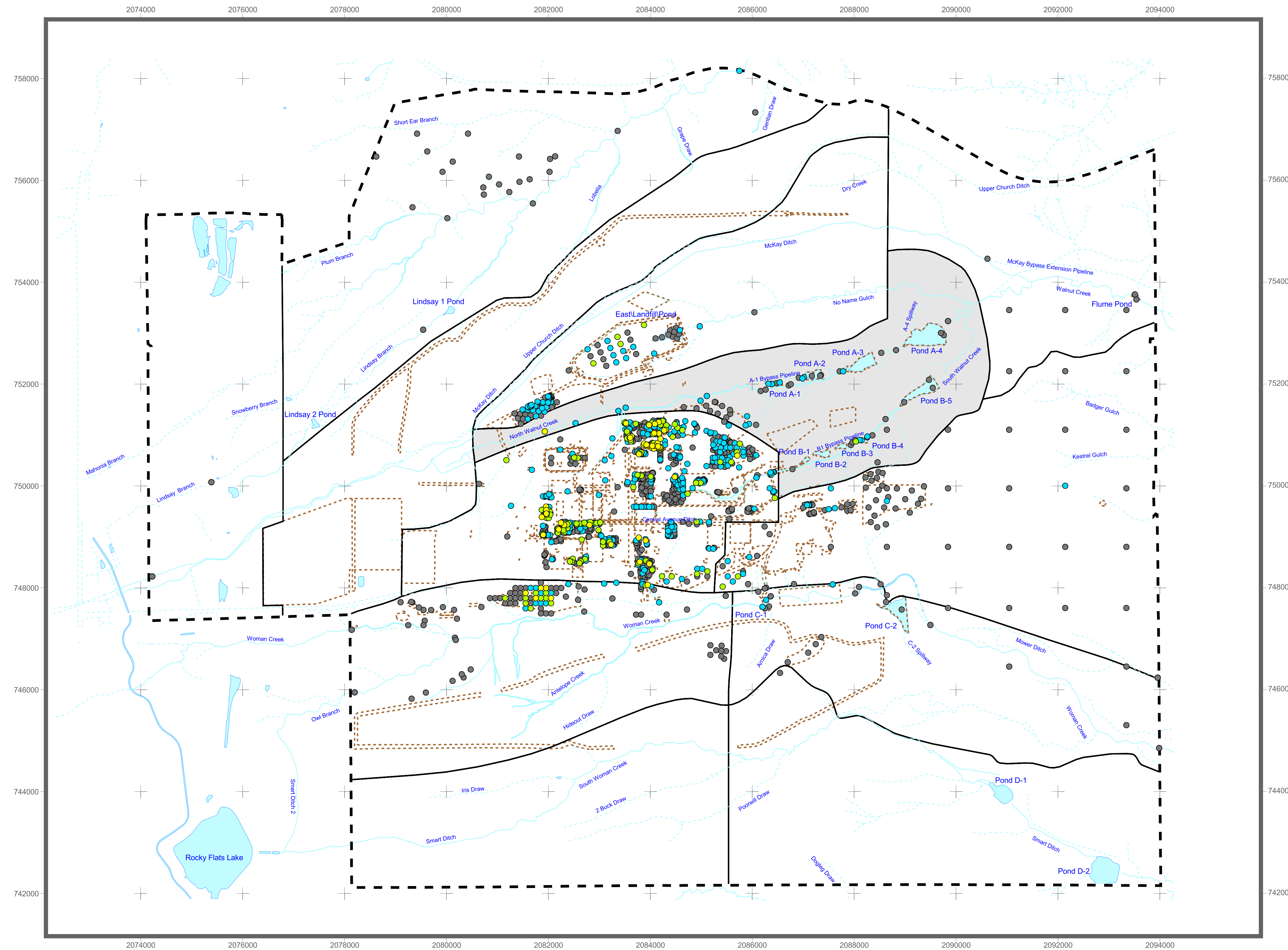


Figure A3.4.2 **Probability Plot for Arsenic Concentrations in UWNEU Surface Soil/Surface Sediment**

Figure A3.4.3

Benzo(a)pyrene Concentrations in Sitewide Surface Soil/Surface Sediment



KEY

- Concentration > 3x WRW PRG
- Concentration > WRW PRG and <= 3x WRW PRG
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 379 ug/kg
3 x WRW PRG = 1,137 ug/kg

Standard Map Features

- Upper Walnut Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\FY2005\CRA\ProfessionalJudgement\FINAL-profjudgment.apr

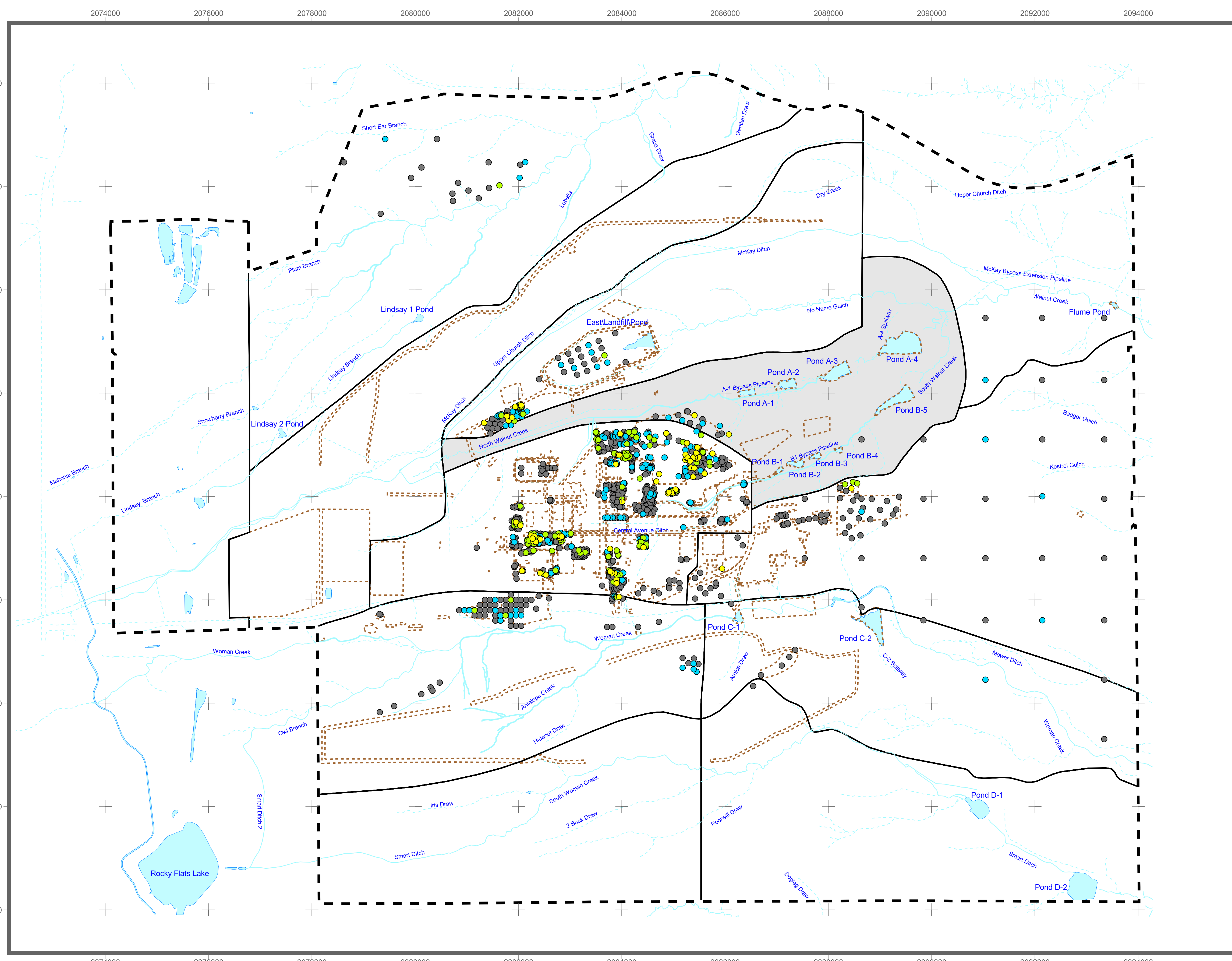


Figure A3.4.4

Bis(2-ethylhexyl)phthalate Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 137 ug/kg
3 x Min. Non-PMJM ESL = 410 ug/kg

Standard Map Features

- Upper Walnut Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\FY2005\CRA\ProfessionalJudgement\FINAL-profjudgment.apr

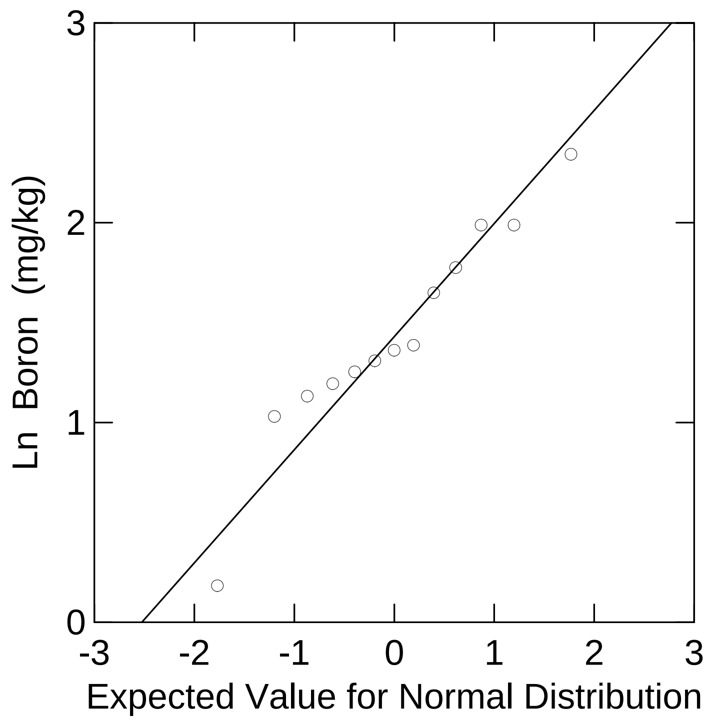
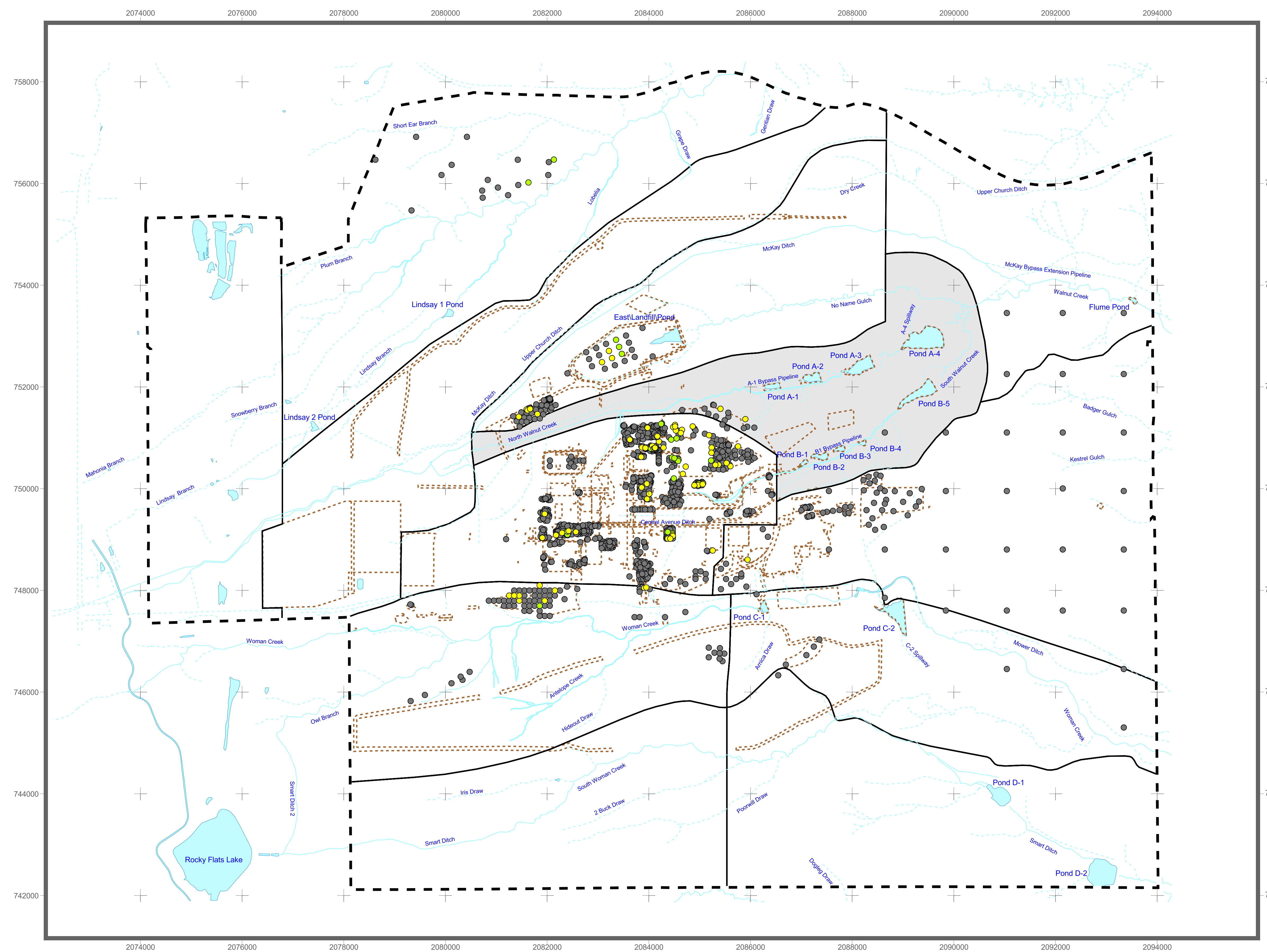


Figure A3.4.5 Probability Plot for Boron Concentrations (Natural Logarithm) in UWNEU Surface Soil

Figure A3.4.6

Di-n-butylphthalate Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 15.9 ug/kg
3 x Min. Non-PMJM ESL = 47.6 ug/kg

Standard Map Features

- Upper Walnut Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
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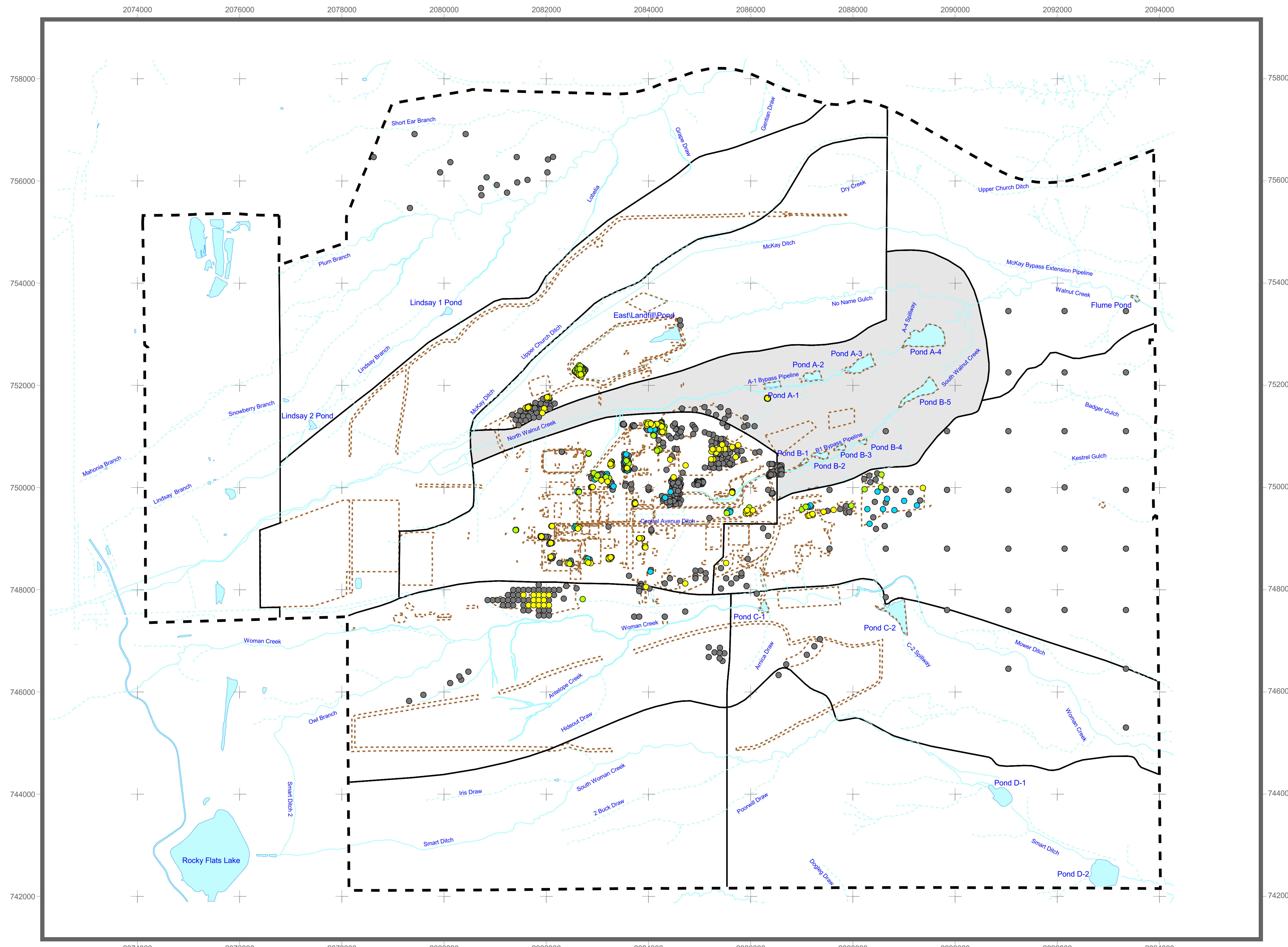
File: W:\Projects\FY2005\CRA\ProfessionalJudgement\FINAL-profjudgment.apr

Figure A3.4.7

Total PCB Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 42.3 ug/kg
3x Min. Non-PMJM ESL = 127 ug/kg

Standard Map Features

- Upper Walnut Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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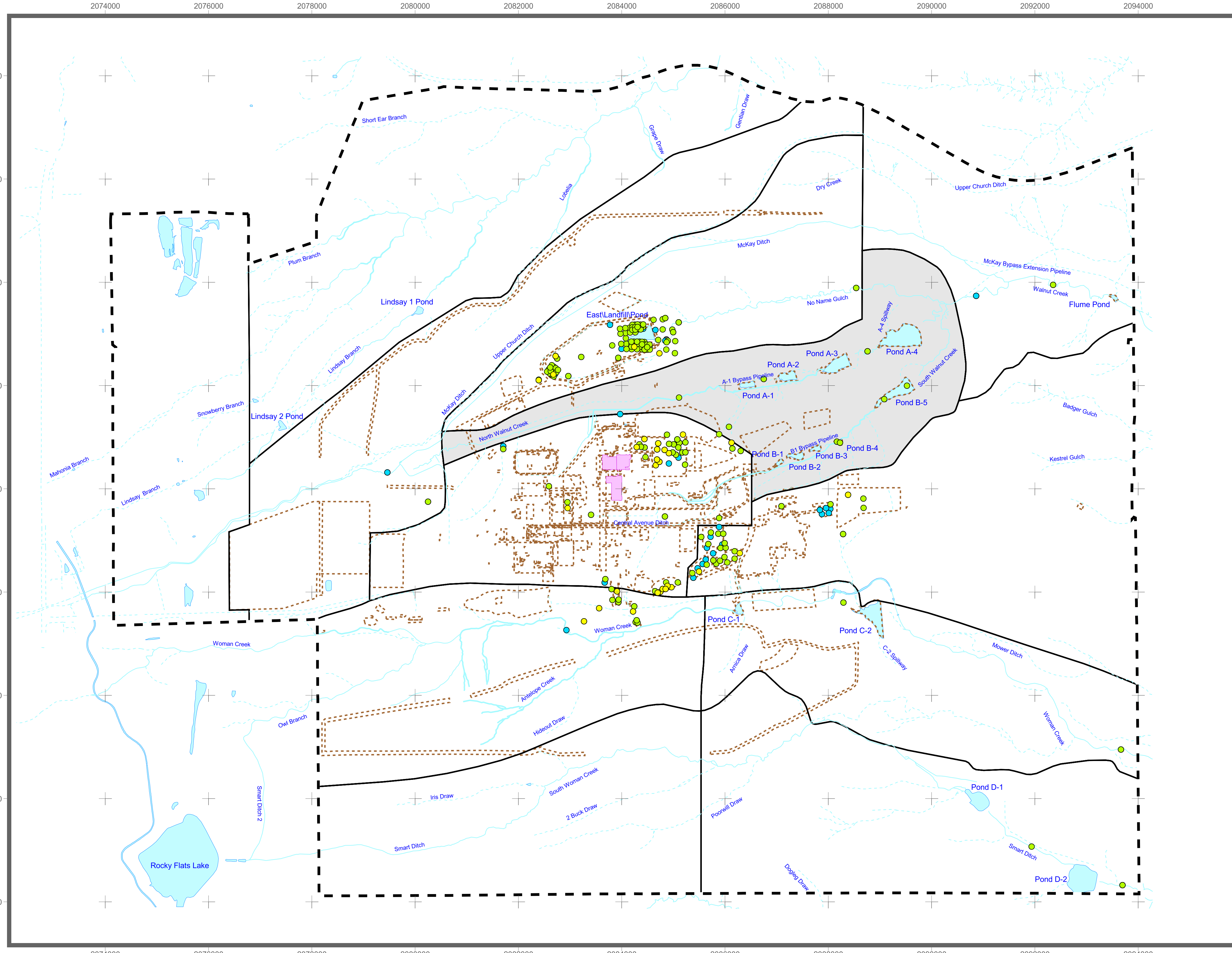

Figure A3.4.8

Radium-228 Activity in Sitewide Subsurface Soil/Subsurface Sediment

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

Subsoil/Subsediment WLRW PRG = 1.28 pCi/g
Background MDC = 2.10 pCi/g
3 x Background MDC = 6.3 pCi/g

Standard Map Features

- Upper Walnut Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

File: W:\Projects\FY2005\CRA\ProfessionalJudgement\FINAL-profjudgment.apr

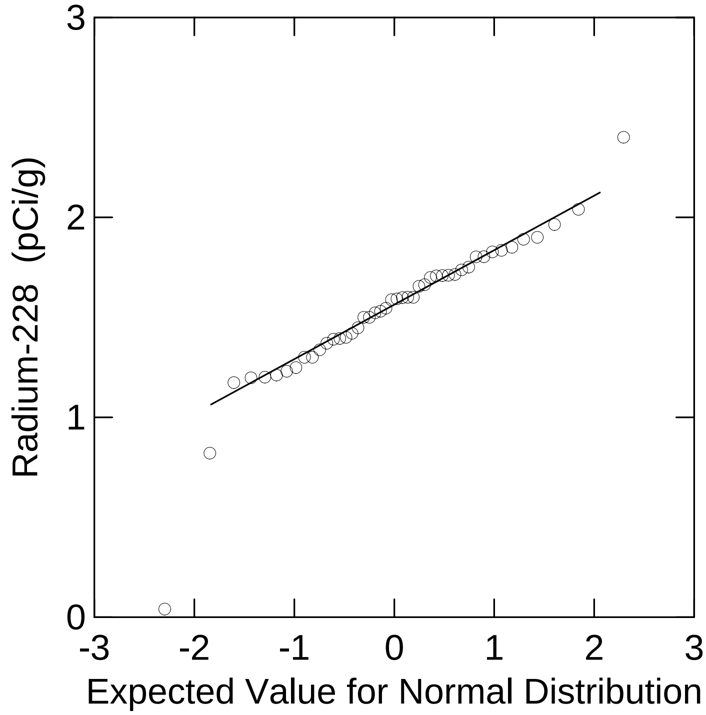

Figure A3.4.9 Probability Plot for Radium-228 Concentrations in UWNEU Subsurface Soil/ Subsurface Sediment

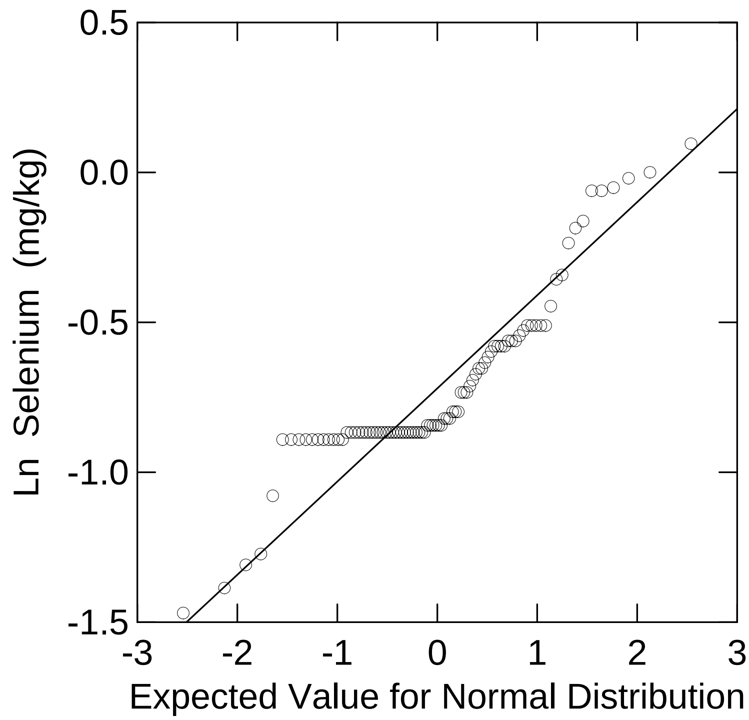

Figure A3.4.10 Probability Plot for Selenium Concentrations (Natural Logarithm) in UWNEU Surface Soil.

COMPREHENSIVE RISK ASSESSMENT

UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 4

Risk Assessment Calculations

TABLE OF CONTENTS

Table A4.1.1

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 1 EPCs

Exposure Route	Contaminant of Concern	Tier 1 EPC (mg/kg)	Cancer Risk Calculations			Non-Cancer Hazard Calculations		
			Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk	Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment								
Ingestion	Benzo(a)pyrene	0.541	1.30E-07	7.3	9.50E-07	4.87E-07	N/A	NC
				Ingestion Total:	**1E-06**		**Ingestion Total:**	**NC**
Inhalation (indoor + outdoor)	Benzo(a)pyrene	0.541	7.71E-10	0.3	2.39E-10	2.89E-09	N/A	NC
				Inhalation Total:	**2E-10**		**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.541	6.53E-08	7.3	4.77E-07	2.45E-07	N/A	NC
				Dermal Total:	**5E-07**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**1E-06**		**Surface Soil/Surface Sediment Total:**	**NC**
				WRW Total:	**1E-06**		**WRW Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.2
Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 2 EPCs

Exposure Route	Contaminant of Concern	Tier 2 EPC (mg/kg)	Cancer Risk Calculations			Non-Cancer Hazard Calculations		
			Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk	Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment								
Ingestion	Benzo(a)pyrene	0.389	9.35E-08	7.3	6.83E-07	3.50E-07	N/A	NC
				Ingestion Total:	**7E-07**		**Ingestion Total:**	**NC**
Inhalation (indoor + outdoor)	Benzo(a)pyrene	0.389	5.54E-10	0.3	1.72E-10	2.07E-09	N/A	NC
				Inhalation Total:	**2E-10**		**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.389	4.70E-08	7.3	3.43E-07	1.76E-07	N/A	NC
				Dermal Total:	**3E-07**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**1E-06**		**Surface Soil/Surface Sediment Total:**	**NC**
				WRW Total:	**1E-06**		**WRW Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.3

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 1 EPCs

Exposure Route	Contaminant of Concern	Tier 1 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk	Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment								
Ingestion	Benzo(a)pyrene	0.541	1.21E-07	7.3	8.84E-07	2.83E-07	N/A	NC
				Ingestion Total:	**9E-07**		**Ingestion Total:**	**NC**
Inhalation (outdoor)	Benzo(a)pyrene	0.541	5.19E-10	0.3	1.61E-10	1.21E-09	N/A	NC
				Inhalation Total:	**2E-10**		**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.541	9.94E-08	7.3	7.26E-07	2.32E-07	N/A	NC
				Dermal Total:	**7E-07**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**2E-06**		**Surface Soil/Surface Sediment Total:**	**NC**
				WRV Total:	**2E-06**		**WRV Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.4

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 2 EPCs

Exposure Route	Contaminant of Concern	Tier 2 EPC (mg/kg)	Cancer Risk Calculations			Non-Cancer Hazard Calculations		
			Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk	Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment								
Ingestion	Benzo(a)pyrene	0.389	8.70E-08	7.3	6.35E-07	2.03E-07	N/A	NC
				Ingestion Total:	**6E-07**		**Ingestion Total:**	**NC**
Inhalation (outdoor)	Benzo(a)pyrene	0.389	3.73E-10	0.3	1.16E-10	8.70E-10	N/A	NC
				Inhalation Total:	**1E-10**		**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.389	7.15E-08	7.3	5.22E-07	1.67E-07	N/A	NC
				Dermal Total:	**5E-07**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**1E-06**		**Surface Soil/Surface Sediment Total:**	**NC**
				WRV Total:	**1E-06**		**WRV Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.2.1

Non-PMJM Intake Estimates for Antimony

Default Exposure Scenario

			Bioaccumulation Factors			
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = -3.233 + 0.938(lnCs)	1	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50)				
			Media Concentrations (mg/kg)			
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
30.2	Tier 1 UTL	0.96	30.2	2.34	0.025	
17.5	Tier 1 UCL	0.58	17.5	1.36	0.014	
20.5	Tier 2 UTL[a]	0.67	20.5	1.59	0.025	
14.4	Tier 2 UCL	0.48	14.4	1.12	0.014	
			Intake Parameters			
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
			Intake Estimates (mg/kg BW day)			
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Herbivore						
Tier 1 UTL	0.1070	N/A	N/A	0.0670	0.00475	0.179
Tier 1 UCL	0.0642	N/A	N/A	0.0389	0.00266	0.106
Tier 2 UTL[a]	0.0744	N/A	N/A	0.0455	0.00475	0.125
Tier 2 UCL	0.0534	N/A	N/A	0.0320	0.00266	0.0881
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.96	N/A	0.0393	0.00475	2.01
Tier 1 UCL	N/A	1.14	N/A	0.0228	0.00266	1.16
Tier 2 UTL[a]	N/A	1.33	N/A	0.0267	0.00475	1.36
Tier 2 UCL	N/A	0.936	N/A	0.0187	0.00266	0.957
Prairie Dog						
Tier 1 UTL	0.0280	N/A	N/A	0.0674	0.00245	0.0978
Tier 1 UCL	0.0168	N/A	N/A	0.0391	0.00137	0.0572
Tier 2 UTL[a]	0.0194	N/A	N/A	0.0458	0.00245	0.0677
Tier 2 UCL	0.0140	N/A	N/A	0.0322	0.00137	0.0475
Coyote - Generalist						
Tier 1 UTL	N/A	0.1133	0.0263	0.0227	0.00200	0.164
Tier 1 UCL	N/A	0.0656	0.0153	0.0131	0.00112	0.0951
Tier 2 UTL[a]	N/A	0.0769	0.0179	0.0154	0.00200	0.112
Tier 2 UCL	N/A	0.0540	0.0126	0.0108	0.00112	0.0785
Coyote - Insectivore						
Tier 1 UTL	N/A	0.453	N/A	0.01268	0.00200	0.468
Tier 1 UCL	N/A	0.263	N/A	0.00735	0.00112	0.271
Tier 2 UTL[a]	N/A	0.308	N/A	0.00861	0.00200	0.318
Tier 2 UCL	N/A	0.216	N/A	0.00605	0.00112	0.223

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

N/A = Not applicable

Table A4.2.2
PMJM Intake Estimates for Antimony
Default Exposure Scenario

Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = -3.223 + 0.938 (ln Cs)	1	N/A				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
17	9.65	MDC	0.33	9.65	N/A	0.078
17	9.65	UTL[a]	0.33	9.65	N/A	0.025
17	6.78	UCL	0.24	6.78	N/A	0.014
17	2.99	Mean	0.11	2.99	N/A	0.011
18	26.5	MDC	0.86	26.50	N/A	0.078
18	22.4	UTL	0.74	22.40	N/A	0.025
18	20.5	UCL	0.68	20.50	N/A	0.014
18	10.2	Mean	0.35	10.20	N/A	0.011
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 17						
MDC	0.0397	0.492	N/A	0.0394	0.0117	0.583
UTL[a]	0.0397	0.492	N/A	0.0394	0.00375	0.575
UCL	0.0285	0.346	N/A	0.0277	0.00210	0.404
Mean	0.0132	0.152	N/A	0.0122	0.00165	0.180
Patch 18						
MDC	0.103	1.35	N/A	0.108	0.0117	1.57
UTL	0.0876	1.14	N/A	0.0914	0.00375	1.33
UCL	0.0806	1.05	N/A	0.0836	0.00210	1.21
Mean	0.0419	0.520	N/A	0.0416	0.00165	0.605

[a]Soil UTL was greater than the MDC, so the MDC was used as a proxy value for calculating intake.
N/A = Not applicable or not available.

Table A4.2.3
Terrestrial Plant Hazard Quotients for Antimony

EPC Statistic	Concentration	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	30.2	5	**6**
Tier 1 UCL	17.5	5	**4**
Tier 2 UTL[a]	20.5	5	**4**
Tier 2 UCL	14.4	5	**3**

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating risk.
No alternative TRVs were available for antimony.
Bold = Hazard quotients>1.

Table A4.2.4
Non-PMJM Receptor Hazard Quotients for Antimony

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Antimony (Default Exposure)					
Deer Mouse - Herbivore					
Tier 1 UTL	0.179	0.06	0.59	**3**	0.3
Tier 1 UCL	0.106	0.06	0.59	**2**	0.2
Tier 2 UTL[a]	0.125	0.06	0.59	**2**	0.2
Tier 2 UCL	0.0881	0.06	0.59	1	0.1
Deer Mouse - Insectivore					
Tier 1 UTL	2.01	0.06	0.59	**34**	**3**
Tier 1 UCL	1.16	0.06	0.59	**19**	**2**
Tier 2 UTL[a]	1.36	0.06	0.59	**23**	**2**
Tier 2 UCL	0.957	0.06	0.59	**16**	**2**
Prairie Dog					
Tier 1 UTL	0.0978	0.06	0.59	**2**	0.2
Tier 1 UCL	0.0572	0.06	0.59	0.95	0.1
Tier 2 UTL[a]	0.0677	0.06	0.59	1	0.1
Tier 2 UCL	0.0475	0.06	0.59	0.8	0.1
Coyote - Generalist					
Tier 1 UTL	0.164	0.06	0.59	**3**	0.3
Tier 1 UCL	0.0951	0.06	0.59	**2**	0.2
Tier 2 UTL[a]	0.112	0.06	0.59	**2**	0.2
Tier 2 UCL	0.0785	0.06	0.59	1	0.1
Coyote - Insectivore					
Tier 1 UTL	0.468	0.06	0.59	**8**	0.8
Tier 1 UCL	0.271	0.06	0.59	**5**	0.5
Tier 2 UTL[a]	0.318	0.06	0.59	**5**	0.5
Tier 2 UCL	0.223	0.06	0.59	**4**	0.4

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A4.2.5
PMJM Hazard Quotients for Antimony

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) NOAEL	TRV (mg/kg BW day) LOAEL	Hazard Quotients NOAEL	Hazard Quotients LOAEL
Antimony (Default Exposure)					
Patch 17					
MDC	0.583	0.06	0.59	**10**	0.99
UTL[a]	0.575	0.06	0.59	**10**	0.97
UCL	0.404	0.06	0.59	**7**	0.7
Mean	0.180	0.06	0.59	**3**	0.3
Patch 18					
MDC	1.57	0.06	0.59	**26**	**3**
UTL	1.33	0.06	0.59	**22**	**2**
UCL	1.21	0.06	0.59	**20**	**2**
Mean	0.605	0.06	0.59	**10**	1

[a]Soil UTL was greater than the MDC, so the MDC was used as a proxy value for calculating intake.
N/A = Not applicable.
Bold = Hazard quotients>1.

Table A4.2.6
Non-PMJM Intake Estimates for Copper
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = 0.669 + 0.394(lnCs)	lnCi = 1.675 + 0.264(lnCs)	lnCsm = 2.042 + .1444(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
31.7	Tier 1 UTL	7.62	13.30	12.69	0.022	
20.3	Tier 1 UCL	6.39	11.82	11.90	0.015	
65.7	Tier 2 UTL[a]	10.15	16.12	14.10	0.022	
22.2	Tier 2 UCL	6.62	12.10	12.06	0.015	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 UTL	1.75	N/A	N/A	0.678	0.00264	2.43
Tier 1 UCL	1.47	N/A	N/A	0.434	0.00180	1.91
Tier 2 UTL[a]	2.34	N/A	N/A	1.405	0.00264	3.74
Tier 2 UCL	1.52	N/A	N/A	0.475	0.00180	2.00
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.06	N/A	0.678	0.00264	3.74
Tier 1 UCL	N/A	2.72	N/A	0.434	0.00180	3.15
Tier 2 UTL[a]	N/A	3.71	N/A	1.405	0.00264	5.11
Tier 2 UCL	N/A	2.78	N/A	0.475	0.00180	3.26

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
N/A = Not applicable.

Table A4.2.7
Non-PMJM Receptor Hazard Quotients for Copper

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Copper (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	2.43	2.3	52.3	1	0.05
Tier 1 UCL	1.91	2.3	52.3	0.8	0.04
Tier 2 UTL[a]	2.60	2.3	52.3	1	0.05
Tier 2 UCL	2.00	2.3	52.3	0.9	0.04
Mourning Dove - Insectivore					
Tier 1 UTL	3.74	2.3	52.3	**2**	0.1
Tier 1 UCL	3.15	2.3	52.3	1	0.1
Tier 2 UTL[a]	3.92	2.3	52.3	**2**	0.1
Tier 2 UCL	3.26	2.3	52.3	1	0.1

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Bold = Hazard quotients>1.

Table A4.2.8
Non-PMJM Intake Estimates for Molybdenum
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.25	2.09	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
2.8	Tier 1 UTL	0.70	5.9	5.73	0.008	
2.86	Tier 1 UCL	0.72	6.0	5.86	0.005	
2.6	Tier 2 UTL[a]	0.65	5.4	5.32	0.008	
1.59	Tier 2 UCL	0.40	3.3	3.26	0.005	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.380	NA	0.00364	0.00152	0.386
Tier 1 UCL	N/A	0.389	NA	0.00372	9.50E-04	0.393
Tier 2 UTL[a]	N/A	0.353	NA	0.00338	0.00152	0.358
Tier 2 UCL	N/A	0.216	NA	0.00207	9.50E-04	0.219

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
N/A = Not applicable.

Table A4.2.9
Terrestrial Plant Hazard Quotients for Molybdenum

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg) Screening ESL	Hazard Quotients Screening ESL
Terrestrial Plant			
Tier 1 UTL	2.8	2	1
Tier 1 UCL	2.86	2	1
Tier 2 UTL[a]	2.6	2	1
Tier 2 UCL	1.59	2	0.8

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Bold = Hazard quotients>1.

Table A4.2.10
Non-PMJM Receptor Hazard Quotients for Molybdenum

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Molybdenum (Default Exposure)					
Deer Mouse - Insectivore					
Tier 1 UTL	0.386	0.26	2.6	1	0.1
Tier 1 UCL	0.393	0.26	2.6	**2**	0.2
Tier 2 UTL[a]	0.358	0.26	2.6	1	0.1
Tier 2 UCL	0.219	0.26	2.6	0.8	0.1

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
Bold = Hazard quotients>1.

Table A4.2.11
Non-PMJM Intake Estimates for Nickel
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
20.1	Tier 1 UTL	1.02	95.1	3.16	0.014	
14.5	Tier 1 UCL	0.80	68.6	2.72	0.009	
17	Tier 2 UTL[a]	0.90	80.4	2.93	0.014	
13.9	Tier 2 UCL	0.77	65.7	2.66	0.009	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	21.9	N/A	0.430	0.00168	22.3
Tier 1 UCL	N/A	15.8	N/A	0.310	0.00108	16.1
Tier 2 UTL[a]	N/A	18.5	N/A	0.364	0.00168	18.9
Tier 2 UCL	N/A	15.1	N/A	0.297	0.00108	15.4
Deer Mouse - Herbivore						
Tier 1 UTL	0.1133	N/A	N/A	0.0446	0.00266	0.161
Tier 1 UCL	0.0887	N/A	N/A	0.0322	0.00171	0.123
Tier 2 UTL[a]	0.1000	N/A	N/A	0.0377	0.00266	0.140
Tier 2 UCL	0.0860	N/A	N/A	0.0309	0.00171	0.119
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	6.18	N/A	0.0261	0.00266	6.21
Tier 1 UCL	N/A	4.46	N/A	0.0189	0.00171	4.48
Tier 2 UTL[a]	N/A	5.23	N/A	0.0221	0.00266	5.25
Tier 2 UCL	N/A	4.27	N/A	0.0181	0.00171	4.29
Coyote - Generalist						
Tier 1 UTL	N/A	0.357	0.0356	0.0151	0.00112	0.408
Tier 1 UCL	N/A	0.257	0.0306	0.0109	7.20E-04	0.299
Tier 2 UTL[a]	N/A	0.302	0.0329	0.0128	0.00112	0.348
Tier 2 UCL	N/A	0.247	0.0300	0.0104	7.20E-04	0.288
Coyote - Insectivore						
Tier 1 UTL	N/A	1.43	N/A	0.00844	0.00112	1.44
Tier 1 UCL	N/A	1.03	N/A	0.00609	7.20E-04	1.04
Tier 2 UTL[a]	N/A	1.21	N/A	0.00714	0.00112	1.21
Tier 2 UCL	N/A	0.986	N/A	0.00584	7.20E-04	0.993

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
NA = Not applicable.

Table A4.2.12
Non-PMJM Intake Estimates for Nickel
Alternative Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
$\ln Cp = -2.224+0.748(\ln Cs)$	1.059	$\ln Cm = -0.2462 + 0.4658(\ln Cs)$				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
20.1	Tier 1 UTL	1.02	21.3	3.16	0.009	
14.5	Tier 1 UCL	0.80	15.4	2.72	0.007	
17	Tier 2 UTL[a]	0.90	18.0	2.93	0.009	
13.9	Tier 2 UCL	0.77	14.7	2.66	0.007	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.38	N/A	0.0261	0.00171	1.41
Tier 1 UCL	N/A	0.998	N/A	0.0189	0.00133	1.02
Tier 2 UTL[a]	N/A	1.17	N/A	0.0221	0.00171	1.19
Tier 2 UCL	N/A	0.957	N/A	0.0181	0.00133	0.976

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
N/A = Not applicable.

Table A4.2.13
PMJM Intake Estimates for Nickel
Default Exposure Scenario

Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
12	15.6	MDC	0.84	73.8	2.81	0.165
12	15.6	UTL[a]	0.84	73.8	2.81	0.014
12	15.6	UCL[a]	0.84	73.8	2.81	0.009
12	13.9	Mean	0.77	65.7	2.66	0.007
15	16	MDC	0.86	75.7	2.84	0.165
15	16	UTL[a]	0.86	75.7	2.84	0.014
15	16	UCL[a]	0.86	75.7	2.84	0.009
15	16	Mean[a]	0.86	75.7	2.84	0.007
17	25	MDC	1.20	118.3	3.50	0.165
17	23.5	UTL	1.15	111.2	3.40	0.014
17	15.9	UCL	0.86	75.2	2.84	0.009
17	13.7	Mean	0.77	64.8	2.65	0.007
18	22.5	MDC	1.11	106.4	3.33	0.165
18	20.6	UTL	1.04	97.4	3.20	0.014
18	15.3	UCL	0.83	72.4	2.79	0.009
18	14.4	Mean	0.80	68.1	2.71	0.007
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 12						
MDC	0.100	3.76	N/A	0.0636	0.0248	3.95
UTL[a]	0.100	3.76	N/A	0.0636	0.00210	3.93
UCL[a]	0.100	3.76	N/A	0.0636	0.00135	3.93
Mean	0.0922	3.35	N/A	0.0567	0.00105	3.50
Patch 15						
MDC	0.102	3.86	N/A	0.0653	0.0248	4.05
UTL[a]	0.102	3.86	N/A	0.0653	0.00210	4.03
UCL[a]	0.102	3.86	N/A	0.0653	0.00135	4.03
Mean[a]	0.102	3.86	N/A	0.0653	0.00105	4.03
Patch 17						
MDC	0.143	6.03	N/A	0.102	0.0248	6.30
UTL	0.137	5.67	N/A	0.0959	0.00210	5.90
UCL	0.102	3.84	N/A	0.0649	0.00135	4.00
Mean	0.0912	3.30	N/A	0.0559	0.00105	3.45
Patch 18						
MDC	0.132	5.43	N/A	0.0918	0.0248	5.68
UTL	0.124	4.97	N/A	0.0840	0.00210	5.18
UCL	0.0990	3.69	N/A	0.0624	0.00135	3.85
Mean	0.0947	3.47	N/A	0.0588	0.00105	3.63

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.
NA = Not applicable or not available.

Table A4.2.14
PMJM Intake Estimates for Nickel
Alternative Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = -2.224+0.748(lnCs)	1.059	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
12	15.6	MDC	0.84	16.5	2.81	0.165
12	15.6	UTL[a]	0.84	16.5	2.81	0.014
12	15.6	UCL[a]	0.84	16.5	2.81	0.009
12	13.9	Mean	0.77	14.7	2.66	0.007
15	16	MDC	0.86	16.9	2.84	0.165
15	16	UTL[a]	0.86	16.9	2.84	0.014
15	16	UCL[a]	0.86	16.9	2.84	0.009
15	16	Mean[a]	0.86	16.9	2.84	0.007
17	25	MDC	1.20	26.5	3.50	0.165
17	23.5	UTL	1.15	24.9	3.40	0.014
17	15.9	UCL	0.86	16.8	2.84	0.009
17	13.7	Mean	0.77	14.5	2.65	0.007
18	22.5	MDC	1.11	23.8	3.33	0.165
18	20.6	UTL	1.04	21.8	3.20	0.014
18	15.3	UCL	0.83	16.2	2.79	0.009
18	14.4	Mean	0.80	15.2	2.71	0.007
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 12						
MDC	0.100	0.843	N/A	0.0636	0.0248	1.03
UTL[a]	0.100	0.843	N/A	0.0636	0.00210	1.01
UCL[a]	0.100	0.843	N/A	0.0636	0.00135	1.01
Mean	0.0922	0.751	N/A	0.0567	0.00105	0.901
Patch 15						
MDC	0.102	0.864	N/A	0.0653	0.0248	1.06
UTL[a]	0.102	0.864	N/A	0.0653	0.00210	1.03
UCL[a]	0.102	0.864	N/A	0.0653	0.00135	1.03
Mean[a]	0.102	0.864	N/A	0.0653	0.00105	1.03
Patch 17						
MDC	0.143	1.35	N/A	0.102	0.0248	1.62
UTL	0.137	1.27	N/A	0.0959	0.00210	1.50
UCL	0.102	0.859	N/A	0.0649	0.00135	1.03
Mean	0.0912	0.740	N/A	0.0559	0.00105	0.888
Patch 18						
MDC	0.132	1.22	N/A	0.0918	0.0248	1.46
UTL	0.124	1.11	N/A	0.0840	0.00210	1.32
UCL	0.0990	0.826	N/A	0.0624	0.00135	0.989
Mean	0.0947	0.778	N/A	0.0588	0.00105	0.932

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.
NA = Not applicable or not available.

Table A4.2.15
Non-PMJM Receptor Hazard Quotients for Nickel

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Mourning Dove - Insectivore									
Tier 1 UTL	22.3	1.38	55.26	77.4	107	**16**	0.4	0.3	0.01
Tier 1 UCL	16.1	1.38	55.26	77.4	107	**12**	0.3	0.2	0.01
Tier 2 UTL[a]	18.9	1.38	55.26	77.4	107	**14**	0.3	0.2	0.01
Tier 2 UCL	15.4	1.38	55.26	77.4	107	**11**	0.3	0.2	0.01
Deer Mouse - Herbivore									
Tier 1 UTL	0.161	0.133	1.33	40	80	1	0.1	0.004	0.002
Tier 1 UCL	0.123	0.133	1.33	40	80	0.9	0.1	0.003	0.002
Tier 2 UTL[a]	0.140	0.133	1.33	40	80	1	0.1	0.004	0.002
Tier 2 UCL	0.119	0.133	1.33	40	80	0.9	0.1	0.003	0.001
Deer Mouse - Insectivore									
Tier 1 UTL	6.21	0.133	1.33	40	80	**47**	**5**	0.2	0.08
Tier 1 UCL	4.48	0.133	1.33	40	80	**34**	**3**	0.1	0.06
Tier 2 UTL[a]	5.25	0.133	1.33	40	80	**39**	**4**	0.1	0.07
Tier 2 UCL	4.29	0.133	1.33	40	80	**32**	**3**	0.1	0.05
Coyote - Generalist									
Tier 1 UTL	0.408	0.133	1.33	40	80	**3**	0.3	0.01	0.005
Tier 1 UCL	0.299	0.133	1.33	40	80	**2**	0.2	0.01	0.004
Tier 2 UTL[a]	0.348	0.133	1.33	40	80	**3**	0.3	0.01	0.004
Tier 2 UCL	0.288	0.133	1.33	40	80	**2**	0.2	0.01	0.004
Coyote - Insectivore									
Tier 1 UTL	1.44	0.133	1.33	40	80	**11**	1	0.04	0.02
Tier 1 UCL	1.04	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Tier 2 UTL[a]	1.21	0.133	1.33	40	80	**9**	0.9	0.03	0.02
Tier 2 UCL	0.993	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Nickel (Alternative Exposure Scenario; Median BAFs)									
Deer Mouse - Insectivore									
Tier 1 UTL	1.41	0.133	1.33	40	80	**11**	1	0.04	0.02
Tier 1 UCL	1.02	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Tier 2 UTL[a]	1.19	0.133	1.33	40	80	**9**	0.9	0.03	0.01
Tier 2 UCL	0.976	0.133	1.33	40	80	**7**	0.7	0.02	0.01

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Table A4.2.15
Non-PMJM Receptor Hazard Quotients for Nickel

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL

Bold = Hazard quotients>1.

Table A4.2.16
PMJM Hazard Quotients for Nickel

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Patch 12									
MDC	3.95	0.133	1.33	40	80	**30**	**3**	0.1	0.05
UTL[a]	3.93	0.133	1.33	40	80	**30**	**3**	0.1	0.05
UCL[a]	3.93	0.133	1.33	40	80	**30**	**3**	0.1	0.05
Mean	3.50	0.133	1.33	40	80	**26**	**3**	0.1	0.04
Patch 15									
MDC	4.05	0.133	1.33	40	80	**30**	**3**	0.1	0.1
UTL[a]	4.03	0.133	1.33	40	80	**30**	**3**	0.1	0.1
UCL[a]	4.03	0.133	1.33	40	80	**30**	**3**	0.1	0.1
Mean[a]	4.03	0.133	1.33	40	80	**30**	**3**	0.1	0.1
Patch 17									
MDC	6.30	0.133	1.33	40	80	**47**	**5**	0.2	0.1
UTL	5.90	0.133	1.33	40	80	**44**	**4**	0.1	0.1
UCL	4.00	0.133	1.33	40	80	**30**	**3**	0.1	0.1
Mean	3.45	0.133	1.33	40	80	**26**	**3**	0.1	0.04
Patch 18									
MDC	5.68	0.133	1.33	40	80	**43**	**4**	0.1	0.1
UTL	5.18	0.133	1.33	40	80	**39**	**4**	0.1	0.1
UCL	3.85	0.133	1.33	40	80	**29**	**3**	0.1	0.05
Mean	3.63	0.133	1.33	40	80	**27**	**3**	0.1	0.05
Nickel (Alternative Exposure Scenario; Median BAFs)									
Patch 12									
MDC	1.03	0.133	1.33	40	80	**8**	0.8	0.03	0.01
UTL[a]	1.01	0.133	1.33	40	80	**8**	0.8	0.03	0.01
UCL[a]	1.01	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean	0.901	0.133	1.33	40	80	**7**	0.7	0.02	0.01

Table A4.2.16
PMJM Hazard Quotients for Nickel

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Patch 15									
MDC	1.06	0.133	1.33	40	80	**8**	0.8	0.03	0.01
UTL[a]	1.03	0.133	1.33	40	80	**8**	0.8	0.03	0.01
UCL[a]	1.03	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean[a]	1.03	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Patch 17									
MDC	1.62	0.133	1.33	40	80	**12**	1	0.04	0.02
UTL	1.50	0.133	1.33	40	80	**11**	1	0.04	0.02
UCL	1.03	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean	0.888	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Patch 18									
MDC	1.46	0.133	1.33	40	80	**11**	1	0.04	0.02
UTL	1.32	0.133	1.33	40	80	**10**	0.99	0.03	0.02
UCL	0.989	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Mean	0.932	0.133	1.33	40	80	**7**	0.7	0.02	0.01

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.

N/A = Not applicable.

Bold = Hazard quotients >1.

Table A4.2.17
Terrestrial Plant Hazard Quotients for Silver

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	2.5	2	1
Tier 1 UCL	1.42	2	0.7
Tier 2 UTL[a]	7.69	2	**4**
Tier 2 UCL	1.49	2	0.7

[a]Soil UTL was greater than the MDC, so the MDC was used as a proxy value for calculating risk.
Bold = Hazard quotients >1.

Table A4.2.18
Non-PMJM Intake Estimates for Tin
Default Exposure Scenario

Bioaccumulation Factors							
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**					
0.03	1	0.21					
Media Concentrations (mg/kg)							
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**		
26.4	Tier 1 UTL	0.79	26.40	5.54	0.025		
11.8	Tier 1 UCL	0.35	11.80	2.48	0.012		
16.1	Tier 2 UTL[a]	0.48	16.10	3.38	0.025		
14.7	Tier 2 UCL	0.44	14.70	3.09	0.012		
Intake Parameters							
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**	
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0	
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0	
American Kestrel	0.092	0.12	0.005	0	0.2	0.8	
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0	
Intake Estimates (mg/kg BW day)							
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**	
Mourning Dove - Herbivore							
Tier 1 UTL	0.182	N/A	N/A	0.565	0.00300	0.750	
Tier 1 UCL	0.0814	N/A	N/A	0.252	0.00144	0.335	
Tier 2 UTL[a]	0.111	N/A	N/A	0.344	0.00300	0.458	
Tier 2 UCL	0.101	N/A	N/A	0.314	0.00144	0.417	
Mourning Dove - Insectivore							
Tier 1 UTL	N/A	6.07	N/A	0.565	0.00300	6.640	
Tier 1 UCL	N/A	2.71	N/A	0.252	0.00144	2.968	
Tier 2 UTL[a]	N/A	3.70	N/A	0.344	0.00300	4.050	
Tier 2 UCL	N/A	3.38	N/A	0.314	0.00144	3.697	
American Kestrel							
Tier 1 UTL	N/A	0.486	0.408	0.1214	0.00300	1.018	
Tier 1 UCL	N/A	0.217	0.182	0.0543	0.00144	0.455	
Tier 2 UTL[a]	N/A	0.296	0.249	0.0741	0.00300	0.622	
Tier 2 UCL	N/A	0.270	0.227	0.0676	0.00144	0.567	
Deer Mouse - Insectivore							
Tier 1 UTL	N/A	1.72	N/A	0.0343	0.00475	1.755	
Tier 1 UCL	N/A	0.767	N/A	0.0153	0.00228	0.785	
Tier 2 UTL[a]	N/A	1.05	N/A	0.0209	0.00475	1.072	
Tier 2 UCL	N/A	0.956	N/A	0.0191	0.00228	0.977	

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
N/A = Not applicable.

Table A4.2.19
PMJM Intake Estimates for Tin
Default Exposure Scenario

Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.03	1	0.21				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
12	29.7	MDC	0.9	29.7	6.2	0.072
12	29.7	UTL[a]	0.9	29.7	6.2	0.025
12	29.7	UCL[a]	0.9	29.7	6.2	0.012
12	11.7	Mean	0.4	11.7	2.5	0.008
17	12.5	MDC	0.4	12.5	2.6	0.072
17	12.5	UTL[a]	0.4	12.5	2.6	0.025
17	7.69	UCL	0.2	7.7	1.6	0.012
17	5.92	Mean	0.2	5.9	1.2	0.008
18	26.4	MDC	0.8	26.4	5.5	0.072
18	18.6	UTL	0.6	18.6	3.9	0.025
18	9.8	UCL	0.3	9.8	2.1	0.012
18	7.05	Mean	0.2	7.1	1.5	0.008
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 12						
MDC	0.106	1.51	N/A	0.121	0.0108	1.75
UTL[a]	0.106	1.51	N/A	0.121	0.00375	1.75
UCL[a]	0.106	1.51	N/A	0.121	0.00180	1.74
Mean	0.0418	0.597	N/A	0.0477	0.00120	0.687
Patch 17						
MDC	0.0446	0.638	N/A	0.0510	0.0108	0.744
UTL[a]	0.0446	0.638	N/A	0.0510	0.00375	0.737
UCL	0.0275	0.392	N/A	0.0314	0.00180	0.453
Mean	0.0211	0.302	N/A	0.0242	0.00120	0.348
Patch 18						
MDC	0.0942	1.35	N/A	0.108	0.0108	1.56
UTL	0.0664	0.949	N/A	0.0759	0.00375	1.09
UCL	0.0350	0.500	N/A	0.0400	0.00180	0.577
Mean	0.0252	0.360	N/A	0.0288	0.00120	0.415

[a]Soil UTL and/or UCL was greater than the MDC, so the MDC was used as a proxy value for calculating intake.
NA = Not applicable or not available.

Table A4.2.20
Non-PMJM Receptor Hazard Quotients for Tin

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Tin (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	0.750	0.73	18.34	1	0.04
Tier 1 UCL	0.335	0.73	18.34	0.5	0.02
Tier 2 UTL[a]	0.458	0.73	18.34	0.6	0.02
Tier 2 UCL	0.417	0.73	18.34	0.6	0.02
Mourning Dove - Insectivore					
Tier 1 UTL	6.64	0.73	18.34	**9**	0.4
Tier 1 UCL	2.97	0.73	18.34	**4**	0.2
Tier 2 UTL[a]	4.05	0.73	18.34	**6**	0.2
Tier 2 UCL	3.70	0.73	18.34	**5**	0.2
American Kestrel					
Tier 1 UTL	1.018	0.73	18.34	1	0.06
Tier 1 UCL	0.455	0.73	18.34	0.6	0.02
Tier 2 UTL[a]	0.622	0.73	18.34	0.9	0.03
Tier 2 UCL	0.567	0.73	18.34	0.8	0.03
Deer Mouse - Insectivore					
Tier 1 UTL	1.76	0.25	15	**7**	0.1
Tier 1 UCL	0.785	0.25	15	**3**	0.1
Tier 2 UTL[a]	1.07	0.25	15	**4**	0.07
Tier 2 UCL	0.977	0.25	15	**4**	0.07

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
Bold = Hazard quotients >1.

Table A4.2.21
PMJM Hazard Quotients for Tin

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Tin (Default Exposure)					
Patch 12					
MDC	1.75	0.25	15	**7**	0.1
UTL[a]	1.75	0.25	15	**7**	0.1
UCL[a]	1.74	0.25	15	**7**	0.1
Mean	0.687	0.25	15	**3**	0.05
Patch 17					
MDC	0.744	0.25	15	**3**	0.05
UTL[a]	0.737	0.25	15	**3**	0.05
UCL	0.453	0.25	15	**2**	0.03
Mean	0.348	0.25	15	**1**	0.02
Patch 18					
MDC	1.56	0.25	15	**6**	0.1
UTL	1.09	0.25	15	**4**	0.1
UCL	0.577	0.25	15	**2**	0.04
Mean	0.415	0.25	15	**2**	0.03

[a]Soil UTL and/or UCL was greater than the MDC, so the MDC was used as a proxy value for calculating intake.
Bold = Hazard quotients >1.

Table A4.2.22
Non-PMJM Intake Estimates for Vanadium
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.0097	0.088	0.0131				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
50.9	Tier 1 UTL	0.49	4.48	0.67	0.025	
37.7	Tier 1 UCL	0.37	3.32	0.49	0.017	
258	Tier 2 UTL[a]	2.50	22.70	3.38	0.025	
55.3	Tier 2 UCL	0.54	4.87	0.72	0.017	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Herbivore						
Tier 1 UTL	0.0548	N/A	N/A	0.113	0.00475	0.173
Tier 1 UCL	0.0406	N/A	N/A	0.0837	0.00323	0.128
Tier 2 UTL[a]	0.278	N/A	N/A	0.573	0.00475	0.855
Tier 2 UCL	0.0595	N/A	N/A	0.123	0.00323	0.186
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.291	N/A	0.0662	0.00475	0.362
Tier 1 UCL	N/A	0.216	N/A	0.0490	0.00323	0.268
Tier 2 UTL[a]	N/A	1.48	N/A	0.335	0.00475	1.82
Tier 2 UCL	N/A	0.316	N/A	0.0719	0.00323	0.391

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
NA = Not applicable

Table A4.2.23
PMJM Intake Estimates for Vanadium
Default Exposure Scenario

Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.0097	0.088	0.0131				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
12	39.1	MDC	0.4	3.4	0.5	0.18
12	39.1	UTL[a]	0.4	3.4	0.5	0.025
12	33.3	UCL	0.3	2.9	0.4	0.017
12	29.1	Mean	0.3	2.6	0.4	0.01
15	45	MDC	0.4	4.0	0.6	0.18
15	45	UTL[a]	0.4	4.0	0.6	0.025
15	45	UCL[a]	0.4	4.0	0.6	0.017
15	45	Mean[a]	0.4	4.0	0.6	0.01
17	40	MDC	0.4	3.5	0.5	0.18
17	40	UTL[a]	0.4	3.5	0.5	0.025
17	32.7	UCL	0.3	2.9	0.4	0.017
17	28.3	Mean	0.3	2.5	0.4	0.01
18	75.9	MDC	0.7	6.7	1.0	0.18
18	75.5	UTL[a]	0.7	6.6	1.0	0.025
18	38.3	UCL	0.4	3.4	0.5	0.017
18	35.2	Mean	0.3	3.1	0.5	0.01
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0

Table A4.2.23
PMJM Intake Estimates for Vanadium
Default Exposure Scenario

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 12						
MDC	0.0451	0.175	N/A	0.160	0.0270	0.407
UTL[a]	0.0451	0.175	N/A	0.160	0.00375	0.384
UCL	0.0384	0.149	N/A	0.136	0.00255	0.326
Mean	0.0336	0.131	N/A	0.119	0.00150	0.284
Patch 15						
MDC	0.0519	0.202	N/A	0.184	0.0270	0.465
UTL[a]	0.0519	0.202	N/A	0.184	0.00375	0.441
UCL[a]	0.0519	0.202	N/A	0.184	0.00255	0.440
Mean[a]	0.0519	0.202	N/A	0.184	0.00150	0.439
Patch 17						
MDC	0.0462	0.180	N/A	0.163	0.0270	0.416
UTL[a]	0.0462	0.180	N/A	0.163	0.00375	0.393
UCL	0.0377	0.147	N/A	0.133	0.00255	0.320
Mean	0.0327	0.127	N/A	0.115	0.00150	0.277
Patch 18						
MDC	0.0876	0.341	N/A	0.310	0.0270	0.765
UTL[a]	0.0871	0.339	N/A	0.308	0.00375	0.738
UCL	0.0442	0.172	N/A	0.156	0.00255	0.375
Mean	0.0406	0.158	N/A	0.144	0.00150	0.344

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.
NA = Not applicable or not available.

Table A4.2.24
Terrestrial Plant Hazard Quotients for Vanadium

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)		Hazard Quotients	
		Screening ESL	Alternate LOEC[a]	Screening ESL	Alternate LOEC
Terrestrial Plant					
Tier 1 UTL	50.9	2	50	**25**	1
Tier 1 UCL	37.7	2	50	**19**	0.8
Tier 2 UTL[b]	258	2	50	**129**	**5**
Tier 2 UCL	55.3	2	50	**28**	1

[a] As cited in Efroymson et al. (1997a)

[b]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating risk.

Bold = Hazard quotients >1.

Table A4.2.25
Non-PMJM Receptor Hazard Quotients for Vanadium

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Vanadium (Default Exposure)					
Deer Mouse - Herbivore					
Tier 1 UTL	0.173	0.21	2.1	0.8	0.08
Tier 1 UCL	0.128	0.21	2.1	0.6	0.06
Tier 2 UTL[a]	0.855	0.21	2.1	**4**	0.4
Tier 2 UCL	0.186	0.21	2.1	0.9	0.09
Deer Mouse - Insectivore					
Tier 1 UTL	0.362	0.21	2.1	**2**	0.2
Tier 1 UCL	0.268	0.21	2.1	1	0.1
Tier 2 UTL[a]	1.82	0.21	2.1	**9**	0.9
Tier 2 UCL	0.391	0.21	2.1	1	0.2

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Bold = Hazard quotients >1.

Table A4.2.26
PMJM Hazard Quotients for Vanadium

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Vanadium (Default Exposure)					
Patch 12					
MDC	0.407	0.21	2.1	**2**	0.2
UTL[a]	0.384	0.21	2.1	**2**	0.2
UCL	0.326	0.21	2.1	**2**	0.2
Mean	0.284	0.21	2.1	1	0.1
Patch 15					
MDC	0.465	0.21	2.1	**2**	0.2
UTL[a]	0.441	0.21	2.1	**2**	0.2
UCL[a]	0.440	0.21	2.1	**2**	0.2
Mean[a]	0.439	0.21	2.1	**2**	0.2
Patch 17					
MDC	0.416	0.21	2.1	**2**	0.2
UTL[a]	0.393	0.21	2.1	**2**	0.2
UCL	0.320	0.21	2.1	**2**	0.2
Mean	0.277	0.21	2.1	1	0.1
Patch 18					
MDC	0.765	0.21	2.1	**4**	0.4
UTL[a]	0.738	0.21	2.1	**4**	0.4
UCL	0.375	0.21	2.1	**2**	0.2
Mean	0.344	0.21	2.1	**2**	0.2

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.

Bold = Hazard quotients >1.

Table A4.2.27
Non-PMJM Intake Estimates for Zinc
Default Exposure Scenario

Bioaccumulation Factors							
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**					
lnCp = 1.575 + 0.554 (ln Cs)	lnCi = 4.449 + 0.328 (ln Cs)	lnCsm = 4.4987 + 0.0745 (ln Cs)					
Media Concentrations (mg/kg)							
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**		
84.3	Tier 1 UTL	56.35	366.31	125.09	0.301		
63	Tier 1 UCL	47.96	332.94	122.41	0.149		
111	Tier 2 UTL[a]	65.63	400.91	127.68	0.301		
67.1	Tier 2 UCL	49.66	339.89	122.98	0.149		
Intake Parameters							
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**	
Mourning Dove - Hervibore	0.23	0.12	0.021	1	0	0	
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0	
American Kestrel	0.092	0.12	0.005	0	0.2	0.8	
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0	
Intake Estimates (mg/kg BW day)							
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**	
Mourning Dove - Herbivore							
Tier 1 UTL	13.0	N/A	N/A	1.80	0.0361	14.8	
Tier 1 UCL	11.0	N/A	N/A	1.35	0.0179	12.4	
Tier 2 UTL[a]	15.1	N/A	N/A	2.37	0.0361	17.5	
Tier 2 UCL	11.4	N/A	N/A	1.44	0.0179	12.9	
Mourning Dove - Insectivore							
Tier 1 UTL	N/A	84.3	N/A	1.80	0.0361	86.1	
Tier 1 UCL	N/A	76.6	N/A	1.35	0.0179	77.9	
Tier 2 UTL[a]	N/A	92.2	N/A	2.37	0.0361	94.6	
Tier 2 UCL	N/A	78.2	N/A	1.44	0.0179	79.6	
American Kestrel							
Tier 1 UTL	N/A	6.74	9.21	0.388	0.0361	16.4	
Tier 1 UCL	N/A	6.13	9.01	0.290	0.0179	15.4	
Tier 2 UTL[a]	N/A	7.38	9.40	0.511	0.0361	17.3	
Tier 2 UCL	N/A	6.25	9.05	0.309	0.0179	15.6	
Deer Mouse - Insectivore							
Tier 1 UTL	N/A	23.8	N/A	0.110	0.0572	24.0	
Tier 1 UCL	N/A	21.6	N/A	0.0819	0.0283	21.8	
Tier 2 UTL[a]	N/A	26.1	N/A	0.144	0.0572	26.3	
Tier 2 UCL	N/A	22.1	N/A	0.0872	0.0283	22.2	

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
NA = Not applicable.

Table A4.2.28
PMJM Intake Estimates for Zinc
Default Exposure Scenario

Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
lnCp = 1.575 + 0.554 (ln Cs)	lnCi = 4.449 + 0.328 (ln Cs)	lnCsm = 4.4987 + 0.0745 (ln Cs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
12	68.4	MDC	50.19	342.04	123.16	1.8
12	68.4	UTL[a]	50.19	342.04	123.16	0.301
12	66.4	UCL	49.37	338.73	122.89	0.149
12	59	Mean	46.25	325.85	121.81	0.088
15	62	MDC	47.53	331.19	122.26	1.8
15	62	UTL[a]	47.53	331.19	122.26	0.301
15	62	UCL[a]	47.53	331.19	122.26	0.149
15	62	Mean[a]	47.53	331.19	122.26	0.088
17	64.1	MDC	48.42	334.83	122.57	1.8
17	64.1	UTL[a]	48.42	334.83	122.57	0.301
17	48.4	UCL	41.44	305.36	120.03	0.149
17	40.4	Mean	37.49	287.79	118.42	0.088
18	650	MDC	174.73	715.83	145.65	1.8
18	222	UTL	96.36	503.25	134.45	0.301
18	125	UCL	70.10	416.83	128.82	0.149
18	99.1	Mean	61.64	386.27	126.61	0.088
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 12						
MDC	5.97	17.4	N/A	0.279	0.270	24.0
UTL[a]	5.97	17.4	N/A	0.279	0.0452	23.7
UCL	5.88	17.3	N/A	0.271	0.0224	23.4
Mean	5.50	16.6	N/A	0.241	0.0132	22.4
Patch 15						
MDC	5.66	16.9	N/A	0.253	0.270	23.1
UTL[a]	5.66	16.9	N/A	0.253	0.0452	22.8
UCL[a]	5.66	16.9	N/A	0.253	0.0224	22.8
Mean[a]	5.66	16.9	N/A	0.253	0.0132	22.8
Patch 17						
MDC	5.76	17.1	N/A	0.262	0.270	23.4
UTL[a]	5.76	17.1	N/A	0.262	0.0452	23.1
UCL	4.93	15.6	N/A	0.197	0.0224	20.7
Mean	4.46	14.7	N/A	0.165	0.0132	19.3
Patch 18						
MDC	20.8	36.5	N/A	2.65	0.270	60.2
UTL	11.5	25.7	N/A	0.906	0.0452	38.1
UCL	8.34	21.3	N/A	0.510	0.0224	30.1
Mean	7.33	19.7	N/A	0.404	0.0132	27.5

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.
NA = Not applicable or not available.

Table A4.2.29
Terrestrial Plant Hazard Quotients for Zinc

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	84.3	50	**2**
Tier 1 UCL	63	50	1
Tier 2 UTL[a]	111	50	**2**
Tier 2 UCL	67.1	50	1

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating risk.

Bold = Hazard quotients>1.

Table A4.2.30
Non-PMJM Receptor Hazard Quotients for Zinc

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Zinc (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	14.8	17.2	172	0.9	0.09
Tier 1 UCL	12.4	17.2	172	0.7	0.07
Tier 2 UTL[a]	17.5	17.2	172	1	0.10
Tier 2 UCL	12.9	17.2	172	0.7	0.07
Mourning Dove - Insectivore					
Tier 1 UTL	86.1	17.2	172	**5**	0.5
Tier 1 UCL	77.9	17.2	172	**5**	0.5
Tier 2 UTL[a]	94.6	17.2	172	**6**	0.6
Tier 2 UCL	79.6	17.2	172	**5**	0.5
American Kestrel					
Tier 1 UTL	16.4	17.2	172	0.95	0.10
Tier 1 UCL	15.4	17.2	172	0.9	0.09
Tier 2 UTL[a]	17.3	17.2	172	1	0.10
Tier 2 UCL	15.6	17.2	172	0.9	0.09
Deer Mouse - Insectivore					
Tier 1 UTL	24.0	9.61	411.4	**2**	0.06
Tier 1 UCL	21.8	9.61	411.4	**2**	0.05
Tier 2 UTL[a]	26.3	9.61	411.4	**3**	0.06
Tier 2 UCL	22.2	9.61	411.4	**2**	0.05

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Bold = Hazard quotients>1.

Table A4.2.31
PMJM Hazard Quotients for Zinc

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Zinc (Default Exposure)					
Patch 12					
MDC	24.0	9.61	411.4	**2**	0.1
UTL[a]	23.7	9.61	411.4	**2**	0.1
UCL	23.4	9.61	411.4	**2**	0.1
Mean	22.4	9.61	411.4	**2**	0.1
Patch 15					
MDC	23.1	9.61	411.4	**2**	0.1
UTL[a]	22.8	9.61	411.4	**2**	0.1
UCL[a]	22.8	9.61	411.4	**2**	0.1
Mean[a]	22.8	9.61	411.4	**2**	0.1
Patch 17					
MDC	23.4	9.61	411.4	**2**	0.1
UTL[a]	23.1	9.61	411.4	**2**	0.1
UCL	20.7	9.61	411.4	**2**	0.1
Mean	19.3	9.61	411.4	**2**	0.05
Patch 18					
MDC	60.2	9.61	411.4	**6**	0.1
UTL	38.1	9.61	411.4	**4**	0.1
UCL	30.1	9.61	411.4	**3**	0.1
Mean	27.5	9.61	411.4	**3**	0.1

[a]Soil UTL and/or UCL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used as a proxy value for calculating intake.

Bold = Hazard quotients>1.

Table A4.2.32
Non-PMJM Intake Estimates for Bis(2-ethylhexyl)phthalate
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.15	34.9	28.81				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
3.6	Tier 1 UTL[a]	0.540	126	104	0.0055	
2.48	Tier 1 UCL	0.372	86.6	71.4	0.0111	
3.6	Tier 2 UTL[a]	0.540	126	104	0.0055	
1.388	Tier 2 UCL	0.208	48.4	40.0	0.0111	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL[a]	N/A	28.9	N/A	0.0770	6.60E-04	29.0
Tier 1 UCL	N/A	19.9	N/A	0.0530	0.00133	20.0
Tier 2 UTL[a]	N/A	28.9	N/A	0.0770	6.60E-04	29.0
Tier 2 UCL	N/A	11.1	N/A	0.0297	0.00133	11.2
American Kestrel						
Tier 1 UTL[a]	N/A	2.31	7.63	0.0166	6.60E-04	9.96
Tier 1 UCL	N/A	1.59	5.26	0.0114	0.00133	6.86
Tier 2 UTL[a]	N/A	2.31	7.63	0.0166	6.60E-04	9.96
Tier 2 UCL	N/A	0.891	2.94	0.00638	0.00133	3.84

[a] Soil UTL was greater than the MDC (Tier 1) or the maximum grid mean (Tier 2), so the MDC (Tier 1) or maximum grid mean (Tier 2) was used as a proxy value to calculate intake.
N/A = Not applicable.

Table A4.2.33
Non-PMJM Receptor Hazard Quotients for Bis(2-ethylhexyl)phthalate

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Bis(2-ethylhexyl)phthalate (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL[a]	29.0	1.1	214	**26**	0.1
Tier 1 UCL	20.0	1.1	214	**18**	0.09
Tier 2 UTL[a]	29.0	1.1	214	**26**	0.1
Tier 2 UCL	11.2	1.1	214	**10**	0.05
American Kestrel					
Tier 1 UTL[a]	9.96	1.1	214	**9**	0.05
Tier 1 UCL	6.86	1.1	214	**6**	0.03
Tier 2 UTL[a]	9.96	1.1	214	**9**	0.05
Tier 2 UCL	3.84	1.1	214	**3**	0.02

[a] Soil UTL was greater than the MDC (Tier 1) or the maximum grid mean (Tier 2), so the MDC (Tier 1) or maximum grid mean (Tier 2) was used as a proxy value to calculate intake.

Bold = Hazard quotients>1.

Table A4.2.34
Non-PMJM Intake Estimates for Di-n-butylphthalate
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.39	30.1	28.43				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.24	Tier 1 UTL	0.09	7.2	6.82	0.0055	
0.221	Tier 1 UCL	0.09	6.7	6.28	0.0111	
0.408	Tier 2 UTL[a]	0.16	12.3	11.60	0.0055	
0.271	Tier 2 UCL	0.11	8.2	7.70	0.0111	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	1.66	N/A	0.00513	6.60E-04	1.67
Tier 1 UCL	N/A	1.53	N/A	0.00473	0.00133	1.54
Tier 2 UTL[a]	N/A	2.82	N/A	0.00873	6.60E-04	2.83
Tier 2 UCL	N/A	1.88	N/A	0.00580	0.00133	1.88
American Kestrel						
Tier 1 UTL	N/A	0.133	0.502	0.00110	6.60E-04	0.637
Tier 1 UCL	N/A	0.122	0.462	0.00102	0.00133	0.587
Tier 2 UTL[a]	N/A	0.226	0.854	0.00188	6.60E-04	1.08
Tier 2 UCL	N/A	0.150	0.567	0.00125	0.00133	0.720

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
NA = Not applicable.

Table A4.2.35
Non-PMJM Receptor Hazard Quotients for Di-n-butylphthalate

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Di-n-butylphthalate (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	1.67	0.11	1.1	**15**	**2**
Tier 1 UCL	1.54	0.11	1.1	**14**	1
Tier 2 UTL[a]	2.83	0.11	1.1	**26**	**3**
Tier 2 UCL	1.88	0.11	1.1	**17**	**2**
American Kestrel					
Tier 1 UTL	0.637	0.11	1.1	**6**	0.6
Tier 1 UCL	0.587	0.11	1.1	**5**	0.5
Tier 2 UTL[a]	1.08	0.11	1.1	**10**	0.98
Tier 2 UCL	0.720	0.11	1.1	**7**	0.7

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
Bold = Hazard quotients>1.

Table A4.2.36
Non-PMJM Intake Estimates for Total PCBs
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	**Soil to Invertebrate**	**Soil to Small Mammal**				
0.25	lnCe = 1.41 + 1.361(lnCs)	28.79				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.27	Tier 1 UTL	0.07	0.69	7.77	N/A	
0.185	Tier 1 UCL	0.05	0.41	5.33	N/A	
0.428	Tier 2 UTL[a]	0.11	1.29	12.32	N/A	
0.3	Tier 2 UCL	0.08	0.80	8.64	N/A	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	0.16	N/A	0.01	N/A	0.164
Tier 1 UCL	N/A	0.09	N/A	0.00	N/A	0.0987
Tier 2 UTL[a]	N/A	0.30	N/A	0.01	N/A	0.306
Tier 2 UCL	N/A	0.18	N/A	0.01	N/A	0.189

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.
NA = Not applicable.

Table A4.2.37
Non-PMJM Receptor Hazard Quotients for Total PCBs

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
PCB (Total) (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	1.64E-01	0.09	1.27	**2**	0.1
Tier 1 UCL	9.87E-02	0.09	1.27	1	0.1
Tier 2 UTL[a]	3.06E-01	0.09	1.27	**3**	0.2
Tier 2 UCL	1.89E-01	0.09	1.27	**2**	0.1

[a]Tier 2 soil UTL was greater than the maximum grid mean, so the maximum grid mean was used as a proxy value for calculating intake.

Bold = Hazard quotients>1.

DRAFT COMPREHENSIVE RISK ASSESSMENT

UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 5

Chemical-Specific Uncertainty Analysis

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

BAF	Bioaccumulation Factors
BW	body weight
CMS	Corrective Measures Study
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOPC	ecological contaminant of potential concern
EcoSSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
mg/kg	milligrams per kilogram
mg/kg BW/day	milligram per kilogram per receptor body weight per day
NOAEL	no observed adverse effect level
PMJM	Preble's meadow jumping mouse
PRC	PRC Environmental Management, Inc
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RFETS	Rocky Flats Environmental Technology Site
TRV	toxicity reference value
UCL	upper confidence limit

UTL	upper tolerance limit
UWNEU	Upper Walnut Exposure Unit

1.0 INTRODUCTION

One potential limitation of the hazard quotient (HQ) approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on two potential sources of uncertainty, described below.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. In order to estimate more typical tissue concentrations, where necessary, an alternative exposure scenario calculated total chemical intake using a 50th percentile (median) BAF and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The Comprehensive Risk Assessment (CRA) Methodology (U.S Department of Energy [DOE] 2005) used an established hierarchy to identify the most appropriate default TRVs for use in the ecological contaminant of potential concern (ECOPC) selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis in the following subsections. When an alternative TRV is identified, the chemical-specific subsections provide a discussion of why the alternative TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternative TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs are discussed for each ECOPC in the following subsections.

1.1 Antimony

Plant Toxicity

Toxicity information on the effects of antimony to plants is extremely limited. The summary of antimony toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the lowest observed effect concentration (LOEC) ecological screening level (ESL) value is based on unspecified toxic effects. No additional TRVs were available in the literature. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default toxicity value.

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Antimony has two types of BAFs used in the intake calculations. For the soil-to-plant BAF, a regression equation from EPA (2003) was used to estimate plant tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In many cases, regression-based models are the best available predictor of tissue concentrations but may still overestimate or underestimate plant tissue concentrations of antimony to an unknown degree.

Considerable uncertainty is placed in the soil-to-invertebrate and soil-to-small mammal BAFs for antimony. No soil-to-invertebrate BAF was identified in the CRA Methodology and, therefore, a default value of 1 was used as the BAF. As a result, all intake calculations assume that antimony concentrations in terrestrial invertebrate tissues are equal to concentrations in surface soils. Because antimony is not typically a bioaccumulative compound, this assumption is likely to overestimate antimony concentrations and subsequent risk estimations to an unknown degree.

The soil-to-small mammal BAF uses both the soil-to-plant and soil-to-invertebrate BAFs in addition to a food-to-small mammal BAF to estimate small mammal tissue concentrations. Given the uncertainties associated with the soil-to-invertebrate TRV and the added uncertainty of the food-to-small mammal BAF, the total uncertainty related to the soil-to-small mammal BAF is large. However, it is unclear as to whether the BAF overestimates or underestimates the concentration of antimony in small mammal tissues, and the degree of effects that the uncertainty has on the intake calculations is unknown.

Toxicity Reference Values

For mammalian receptors, review of the toxicity data provided in EPA (2003) indicates that only one bounded lowest observed adverse effect level (LOAEL), used in the risk estimation, is lower than the geometric mean of growth and reproduction no observed adverse effect level (NOAEL) TRVs. All other bounded LOAEL TRVs for growth, reproduction, and mortality are more than an order of magnitude greater than the NOAEL and LOAEL used as the default TRVs. The default NOAEL and LOAEL TRVs for antimony are based on a decrease in rat progeny weight, and the effect of a predicted decrease in birth weight on the mammalian receptors in the Upper Walnut Exposure Unit (UWNEU) is unknown. Since the endpoint for the LOAEL TRV is based on an acceptable endpoint as defined by the CRA methodology, the overall uncertainty related to the antimony TRVs should be considered to be low. However, the combination of the TRV endpoint of questionable applicability toward measuring the assessment endpoint and the review of the entire TRV database that indicated the LOAEL concentration is significantly lower than the remainder of the applicable effects-based TRVs reviewed by EPA (2003) suggests that the uncertainties should be carefully considered in risk management decisions.

Background Risk Calculations

Antimony was not detected in background surface soils. Therefore, background risks were not calculated for antimony in Appendix A, Volume 2, Attachment 9 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

1.2 Copper

Bioaccumulation Factors

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of copper to an unknown degree.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for birds were obtained from PRC Environmental Management, Inc. (PRC) (PRC 1994). The PRC document reviewed the available effects database for avian effects from copper. The NOAEL TRV represents a dose of copper at which no growth, developmental, reproductive, or mortality effects were noted. The LOAEL TRV represents a dose rate at which an increase in the erosion of chicken gizzards was noted. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies given the available data. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at the Rocky Flats Environmental Technology Site (RFETS) under the assessment endpoints used in this CRA is uncertain. The effect that gizzard erosion in birds has on population-level endpoints is unclear, but risk estimations are likely to be conservative and over-predict risk. However, Sample et al. (1996), a CRA Methodology-approved TRV source, provides avian TRVs for growth and mortality endpoints to neonate chickens that are very similar to the LOAEL TRV from PRC (PRC - LOAEL = 52.3 milligrams per kilogram per receptor body weight per day [mg/kg BW/day]); Sample - LOAEL = 61.7 mg/kg BW/day). Because the two LOAEL values are similar, the uncertainty in the PRC LOAEL is reduced and no alternative TRVs are provided to calculate risk to the mourning dove receptors. The PRC value is considered to be protective of growth and mortality effects in birds. Although it may over-predict risks, the degree is likely to be small.

Background Risks

Copper was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the mourning dove (herbivore and insectivore) were calculated using both the upper confidence limit (UCL) and upper tolerance limit (UTL) of background soils. No HQs greater than 1 were calculated for either receptor using the NOAEL, threshold, or LOAEL TRVs. NOAEL HQs equal to 1 were calculated for the mourning dove (insectivore) with both the UCL and UTL exposure point concentrations (EPCs). NOAEL HQs for the mourning dove (herbivore) were less than 1 for the UCL and UTL EPCs.

1.3 Molybdenum

Plant Toxicity

Toxicity information on the effects of molybdenum on plants is extremely limited. The summary of molybdenum toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants, and the LOEC ESL value is based on unspecified toxic effects. No alternative TRVs were available in the literature. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default toxicity value, but overestimation is the more likely scenario.

Bioaccumulation Factors

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations for the deer mouse (insectivore) is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate molybdenum concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be used as an alternative BAF to estimate invertebrate tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which an increased incidence of runts in mice litters was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risk Calculations

Molybdenum was not detected in background surface soils. Therefore, background risks were not calculated for molybdenum in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.4 Nickel

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Nickel has two types of bioaccumulation factors used in the intake calculations. For the soil-to-plant and soil-to-small mammal BAFs, regression equations were used to estimate tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of nickel to an unknown degree.

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate nickel concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be used as an alternative BAF to estimate invertebrate tissue concentrations.

It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

Uncertainty is also present in the TRVs used in the default HQ calculations for nickel. The NOAEL-based ESL calculated for the deer mouse (insectivore) was equal to 0.431 milligram per kilogram (mg/kg), a concentration less than all site-specific background samples (minimum background concentration = 3.8 mg/kg). The NOAEL TRV used to calculate the ESL was estimated from the LOAEL TRV in the CRA Methodology by dividing by a factor of 10. The LOAEL TRV for mammals (1.33 mg/kg BW/day) is based on pup mortality in rats. Given that the LOAEL TRV is 10 times the NOAEL TRV, a back-calculated soil concentration using the LOAEL TRV equals 3.8 mg/kg. This concentration is equal to the minimum detected concentration of nickel in background soils and would be exceeded by 19 of the 20 site-specific background soil concentrations.

For avian receptors, there is also uncertainty in the quality of the TRVs selected in the CRA Methodology to predict population-level effects to birds at RFETS. The TRVs selected by PRC (1994) relate to the prediction of edema and swelling in leg and foot joints in mallard ducks. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at RFETS under the assessment endpoints used in this CRA is also uncertain. The effect that swelling of leg and toe joints in birds has on population-level endpoints is unclear and risk estimations are likely to be conservative and over-predict risks related to the assessment endpoints.

Given the uncertainties related to the TRVs for both mammals and birds, a further review of TRVs was conducted to provide additional toxicologically-based information for use in the risk characterization. The CRA Methodology prescribed a hierarchy of TRV sources from which TRVs could be identified and used without modification. TRVs were selected first from U.S. Environmental Protection Agency (EPA) Eco-SSL guidance (EPA 2003) from which no nickel TRVs were available. The second tier TRV source was PRC (1994), from which the TRVs were obtained. Due to the uncertain nature of predicting potential risk at even the lowest end of the range of background concentrations in an uncontaminated background area, additional TRVs were identified from the third tier TRV source (Sample et al. 1996). Sample et al. (1996) presents TRVs for birds and mammals that provide useful comparison points to the default TRVs identified in the CRA Methodology.

For mammals, additional TRVs were derived from a multi-generational study of rat reproduction and changes due to nickel contamination in food items. At a dose level equal to 80 mg/kg BW/day (LOAEL), significant decreases were noted in offspring weight in rats. No effects were noted at 40 mg/kg BW/day (NOAEL). The effect-endpoint is questionable in terms of predicting population level effects based on the assessment endpoint, but was identified as an acceptable endpoint in the CRA Methodology. These values can be used in conjunction with the median BAFs discussed above to provide risk managers with another valuable line of evidence to be used in making risk management decisions.

For birds, the additional TRVs were derived from a chronic exposure study on mallard ducklings exposed to nickel in food items. No growth, reproductive or mortality-based effects were noted at the 77.4 mg/kg BW/day dose level (NOAEL) but significant decreased in growth rate and increased in mortality were noted at the 107 mg/kg BW/day dose level (lowest observed effect level [LOEC]). As with the additional mammalian TRVs, these values can be used in conjunction with the median BAFs discussed above to provide risk managers with another valuable line of evidence to be used in making risk management decisions.

The use of these additional risk calculations provides an estimate of risk using a reasonable, yet reduced, level of conservatism for all receptors and a reduction of uncertainty (to an unknown extent) for the deer mouse (insectivore) and Preble's meadow jumping mouse (PMJM) receptors.

Background Risks

Nickel was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM, deer mouse (insectivore and herbivore), coyote (generalist and insectivore), and mourning dove (insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs.

NOAEL HQs greater or equal to 1 for all receptors were calculated using both the UCL and UTL background surface soil concentrations. NOAEL HQs ranged from 1 for the deer mouse (herbivore) to 27 for the PMJM. LOAEL HQs were less than 1 for the deer mouse (herbivore), mourning dove (insectivore), and both coyote receptors but greater than 1 for the PMJM (HQ = 3) and deer mouse (insectivore) (HQ = 3). Site-specific background concentrations of nickel do not appear to be elevated as the maximum detected concentration in background surface samples equaled 14.0 mg/kg which is lower than the mean concentration of nickel in Colorado and bordering states (18.8 mg/kg) as discussed in Attachment 3.

1.5 Silver

Plant Toxicity

The summary of silver toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants, and the LOEC ESL value is based on unspecified toxic effects. The only additional TRV information available in the literature was an ESL soil screening benchmark from EPA Region 5. Low confidence is also placed in this benchmark value because no effects are specified and the benchmark is based on the lowest receptor-specific ESL for either plants, invertebrates, or mammals. The uncertainty associated with the lack of toxicity data for silver is high. It is unclear whether risks are overestimated or underestimated by using the default ESL or the Region 5 benchmark. However, overestimation is the more likely scenario because the default and Region 5 benchmark are termed screening levels and represent unclear effects. Because of the uncertainties associated with the Region 5 benchmark, no refined analysis is presented in the risk characterization.

Background Risk Calculations

Silver was not detected in background surface soils. Therefore, background risks were not calculated for silver in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.6 Tin

Bioaccumulation Factors

The primary source of uncertainty in the risk estimation for tin is in the estimation of tissue concentrations. No high-quality regression models or BAF data were available for any of the three soil-to-tissue pathways. As a result, plant tissue concentrations are estimated using a biotransfer factor from soil-to-plant tissue from Baes et al. (1984). The values presented in Baes et al. (1984) were the lowest tier for data quality in the CRA Methodology and represent the most uncertain BAF available. It is unclear whether the Baes et al. (1984) BAFs overestimate or underestimate uptake into plant tissues, and the magnitude of uncertainty is also unknown but could be high.

No data were available to estimate invertebrate concentrations from soil. As a result, a default value of 1 was used. This value assumes that the concentration in invertebrate tissues is equal to the surface soil concentration. There is a large degree of uncertainty in this assumption. Because tin is not expected to bioaccumulate in the food chain, invertebrate tissue concentrations are likely to be overestimated to an unknown degree using this BAF. The lack of quality soil-to-plant and soil-to-invertebrate BAFs directly affects the quality of the soil-to-small mammal BAF that uses the previous two values in its calculation. Compounding the uncertainty for this BAF is a food-to-tissue BAF, again from Baes et al. (1984). It is unclear to what degree and direction that uncertainty can be estimated for the soil-to-small mammal BAF, but the uncertainty associated with the estimated small mammal tissue concentrations is high.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994). The selected NOAEL TRV is protective of systemic effects in mice. These effects are not associated with the assessment endpoints for mammalian receptors at RFETS and, therefore, are overly conservative for use in the CRA. However, the LOAEL TRV selected by PRC (1994) is from a proper endpoint for use in the CRA and is described by PRC (1994) as predictive of a mid-range of effects less than mortality. Therefore, while the uncertainty related to the NOAEL TRV for mammals is high, the uncertainty for the LOAEL TRV is considerably lower. For this reason, no alternative TRVs are recommended in the uncertainty analysis.

For avian receptors, the TRVs selected for use in the CRA were also obtained from PRC (1994) and represent a paired NOAEL and LOAEL from a study on Japanese quail reproduction. No effects on reproduction were noted at the NOAEL, while reduced reproduction was noted at the LOAEL intake rate. Because the endpoints represented by the TRVs are appropriate for use in the CRA, the uncertainty in the avian TRVs for tin is considered to be low.

All of the TRVs used for tin were based on toxicity to tributyl tin. Tributyl tin compounds are commonly regarded as the most toxic forms of tin while inorganic tins are likely to be among the least toxic forms. In terrestrial environments, organic forms of tin, such as tributyl tin, on which the TRVs are based are not generally found in elevated concentrations unless a source of them is nearby. No known source of organic tin is present at RFETs. It is likely that much of the tin detected in soil samples is either inorganic tin or in compounds less toxic than tributytin. The use of tributyltin TRVs likely overestimates risks from tin to an unknown degree.

Background Risk Calculations

Tin was not detected in background surface soils, therefore, background risks were not calculated for tin in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.7 Vanadium

Plant Toxicity

The summary of vanadium toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants, and the LOEC ESL value is based on unspecified toxic effects. An additional LOEC TRV was also available as cited in Efroymson et al. (1997a) and was based again on unspecified effects of vanadium added to soil at a concentration of 50 mg/kg. No information regarding the baseline concentration of vanadium in the soil was available. Low confidence is also placed on this additional LOEC value. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default or additional LOEC value, but overestimation at the screening ESL is the more likely scenario. The additional LOEC may reduce that uncertainty to an unknown degree.

Bioaccumulation Factors

The soil-to-invertebrate and soil-to-plant BAFs used to estimate invertebrate tissue concentrations are both based on screening-level upper-bound (90th percentile) BAFs presented in Sample et al. (1998a) and ORNL (1998). These values provide conservative estimates of uptake from soils to invertebrate and plant tissues. This conservative estimate may serve to overestimate vanadium concentrations in tissues.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which a decrease in reproductive success in mice was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is also unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL

TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risks

Vanadium was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the terrestrial plant, PMJM, and deer mouse (insectivore and herbivore) were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs. HQs equal to 23 and 15 were calculated for the terrestrial plant receptor using UTL and UCL EPCs, respectively. NOAEL HQs greater or equal to 1 were calculated using both the UCL and UTL background surface soil concentrations for the PMJM and deer mouse (insectivore) receptors. NOAEL HQs ranged from 1 for both receptors using the UCL to 2 for both receptors using the UTL EPCs. LOAEL HQs were less than 1 for all three receptors.

1.8 Zinc

Plant Toxicity

The summary of zinc toxicity in Efroymson et al. (1997a) places moderate confidence in the benchmark ESL of 50 mg/kg. This benchmark is based on over ten studies that show specified effects on plant growth. Although there are additional NOEC and LOEC values in Efroymson et al (1997a), no particular value is recommended as an additional benchmark to be used in a refined analysis. For zinc, the uncertainty associated with the lack of toxicity data for terrestrial plants is considered moderate. It is unclear whether risks are overestimated or underestimated by using the default ESL, but overestimation is the more likely scenario.

Bioaccumulation Factors

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of zinc to an unknown degree.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which there is an increased incidence of fetal developmental effects in rats.

No NOAEL TRV was available; therefore, the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks, and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

The NOAEL and LOAEL TRVs for avian receptors were also obtained from PRC (1994). The LOAEL TRV represents an intake rate at which a decrease in body weight of mallard ducks may be predicted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake rate the true NOAEL lies. In addition, this source of uncertainty may be compounded because the LOAEL TRV is predictive of effects that are questionable in their ability to predict population-level effects related to the assessment endpoints. Risks predicted by the LOAEL TRV may be overestimated, by an uncertain degree.

Background Risks

Zinc was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the terrestrial plant, PMJM, deer mouse (insectivore), mourning dove (herbivore and insectivore), and American kestrel were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs.

HQs equal to 2 and 1 were calculated for the terrestrial plant receptor using UTL and UCL EPCs, respectively. Because no exposure modeling is conducted for terrestrial plants, this indicates that the ESL is likely to be slightly conservative when assessing risks to plant populations. This conservatism should be considered when viewing the results of the risk characterization for zinc.

NOAEL HQs greater than 1 were calculated using both the UCL and UTL background surface soil concentrations for the PMJM, deer mouse (insectivore), and mourning dove (insectivore), receptors. NOAEL HQs ranged from 2 for deer mouse (insectivore), using both EPCs, to 5 for the mourning dove (insectivore), using the UTL. LOAEL HQs were less than 1 for all receptors.

1.9 Bis(2-ethylhexyl)phthalate

Bioaccumulation Factors

Invertebrate tissue concentrations for bis(2-ethylhexyl)phthalate were estimated using uptake models based on the log K_{ow} of bis(2-ehtylhexyl)phthalate. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in the EPA Eco-SSL [EPA 2003]). Log K_{ow} -based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate and the soil-to-plant BAFs (also log K_{ow}-based) to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is the used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of bis(2-ethylhexyl)phthalate by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

Appendix B of the CRA Methodology (DOE 2005) presents only a NOAEL TRV for avian effects from bis(2-ethylhexyl)phthalate. No reproductive effects were noted in ring doves at a dose of 1.1 mg/kg BW/day. Because no effects were noted at the highest dose level in the study presented in the CRA Methodology, EPA's Ecotox database was searched for an alternative study. The following study was identified as applicable for use in the risk characterization.

European starlings were fed a concentration of 0, 25, and 250 mg/kg bis(2-ethylhexyl)phthalate via diet daily (O'Shea and Stafford 1980). Significant increases in body weight were noted at the 25 mg/kg level, which was identified as the LOAEL. The water content of the food was assumed to be 5 percent.

The effect of increased body weight on the health of bird populations are questionable. Bis(2-ethylhexyl)phthalate commonly causes an increase in liver weight in mammals, thus, it can be assumed that the same may be true in birds. Therefore, the resulting TRV can be used as the LOAEL for the risk characterization assuming that any predicted increase in body weight may be attributable to increases in organ weight. It is unknown what effect the increase of organ weight in birds may have on the assessment endpoints, however, LOAEL-based HQs serve to provide risk managers with an additional line of evidence with which to make risk management decisions. Potential adverse effects predicted for bird populations from exposure to bis(2-ethylhexyl)phthalate are uncertain and should be reviewed in terms of the quality of toxicological information available.

No food ingestion rates for the animals used in the study were provided in the Ecotox database, so they were estimated. The ingestion rate for the American robin (EPA 1993) was used as a surrogate (food ingestion rate = 1.52 g/g BW/day). Converting the 25-mg/kg concentration to a dose resulted in a LOAEL TRV equal to 31.6 mg/kg BW day.

$$Dose = Cdiet \cdot CF \cdot IRfood = 25 \cdot (1 - 0.05) \cdot 1.52 = 36.1 \text{ mg/kg BW/d}$$

Where:

Dose = exposure dose (mg/kg BW/d)

Cdiet = exposure concentration in diet (mg/kg food dry weight)

CF = dry weight to wet weight conversion factor [equal to 1- percent moisture]

IRfood = food ingestion rate (kg food wet weight/kg BW/d)

Given the questionable endpoint used in the LOAEL study, risks calculated using the LOAEL are likely to be overestimated to an unknown degree. However, the results of the LOAEL HQ calculations should be viewed in terms of the NOAEL HQs to provide an additional line of evidence regarding the lack of toxicity to bird species from bis(2-ethylhexyl)phthalate. The overall uncertainty associated with the TRVs used to assess risk to avian receptors from bis(2-ethylhexyl)phthalate is high.

Background Risk Calculations

Bis(2-ethylhexyl)phthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for bis(2-ethylhexyl)phthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.10 Di-n-butylphthalate

Bioaccumulation Factors

Invertebrate tissue concentrations for di-n-butylphthalate were estimated using uptake models based on the log K_{ow} of di-n-butylphthalate. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in the EPA Eco-SSL [EPA 2003]). Log K_{ow}-based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate and the soil-to-plant BAFs (also log K_{ow}-based) to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is the used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of di-n-butylphthalate by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

The TRV used was obtained from Sample et al. (1996) from a study of reproductive effects in ring doves. Changes in eggshell thickness were noted at the LOAEL intake rate. No NOAEL TRV was available, therefore, the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risk Calculations

Di-n-butylphthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for di-n-butylphthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.11 Polychlorinated Biphenyls (Total)

Bioaccumulation Factors

For the soil-to-invertebrate BAF, regression equations was used to estimate invertebrate tissue concentrations. Confidence placed in this value is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAF may overestimate or underestimate tissue concentrations of total polychlorinated biphenyls (PCBs) to an unknown degree.

Plant tissue concentrations for total PCBs were estimated using uptake models based on its log K_{ow} (Aroclor 1254 used as a surrogate) . As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in EPA Eco-SSL guidance [EPA 2003]). Log K_{ow}-based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate regression model and the soil-to-plant BAF to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of total PCBs by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

For avian receptors, total PCB TRVs were obtained from the database of TRVs from PRC (1994). The LOAEL TRV was derived from a study of reproductive effects in chickens. At the LOAEL intake rate, a significant decrease in egg hatchability was noted. The NOAEL TRV is set at an intake rate that showed potential effects on egg hatchability in chickens and then reduced by one-tenth to convert the concentration to a NOAEL. Because the NOAEL and LOAEL TRVs came from two different studies with different methods and the NOAEL TRV was estimated from an effect-based TRV, no threshold TRV has been calculated for birds. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWNEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

Background Risk Calculations

PCBs were not analyzed for in background surface soils. Therefore, background risks were not calculated for PCB in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

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COMPREHENSIVE RISK ASSESSMENT

UPPER WALNUT DRAINAGE EXPOSURE UNIT

VOLUME 7: ATTACHMENT 6

CRA Analytical Data Set